LOUDOUN COUNTY ENERGY STRATEGY APPENDICES

As Approved by the
Loudoun County Board of Supervisors
on December 15th, 2009

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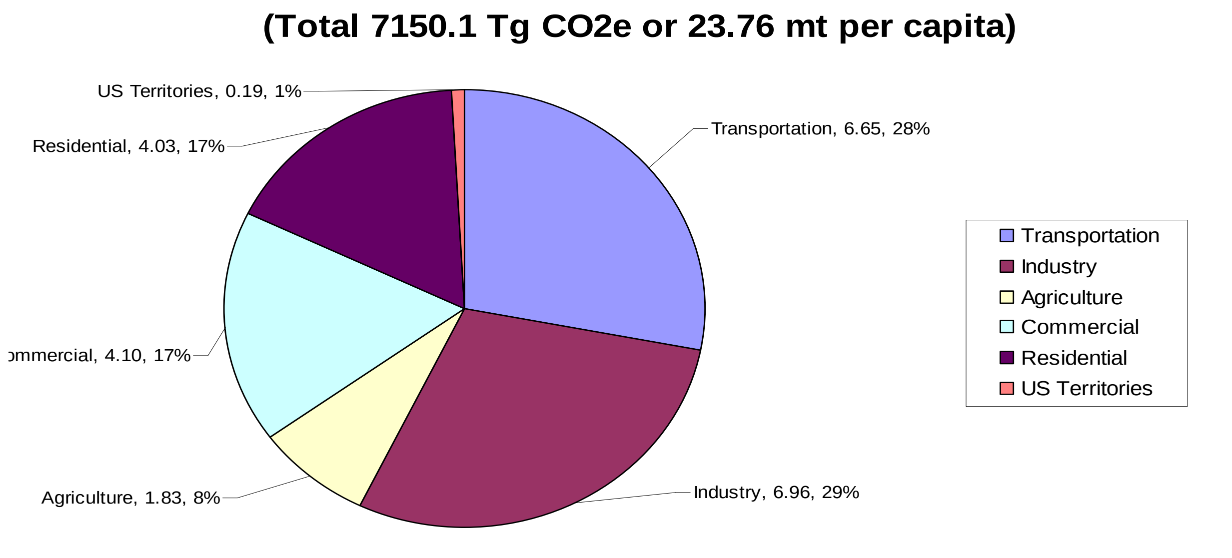
Appendix A: US GHG Emissions – Background

Greenhouse gas emissions are an important consideration as a result of their contribution to climate change. In 2007, the total carbon dioxide equivalent (CO_2e) emissions totaled 7,150.1 Tg (Tg being a million metric tons) or 23.76 mt per capita (see Figure A.1).

Figure A.1: US 2007 GHG Emissions Allocated to Economic Sectors[1]

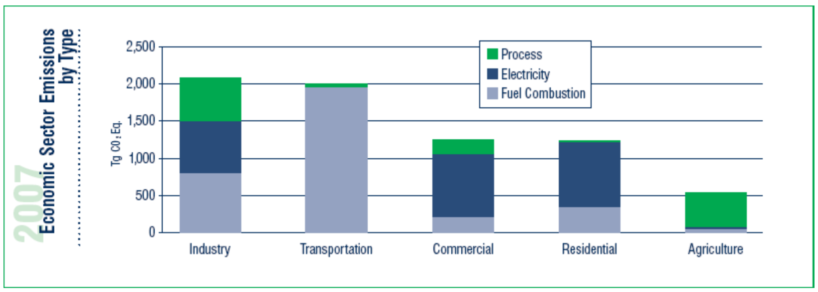


In the US the transportation sector is a leading contributor of greenhouse gas emissions. CO_2 emissions from the transportation sector accounted for 2,000.1 Tg CO_2e or 28% of the 2007 US total emissions (see Figure A.2), an amount representing 6.63 mt per capita. This percentage includes the CO_2 emissions from combustion, electricity and other GHG gases – CH_4, N_2O, HFCs, PFCs and SF_4 as attributable to transportation.

[1] EPA, *Inventory of US Greenhouse Gas Emissions and Sinks: 1990 – 2007*

Figure A.2: US Greenhouse Gas Emissions Allocated to Economic Sectors with Electricity Distributed (Tg Co2 Eq.)[2]

Implied Sectors	1990	1995	2000	2005	2006	2007
Industry	2,166.5	2,219.8	2,235.5	2,081.2	2,082.3	2,081.2
Transportation	1,546.7	1,688.3	1,923.2	2,003.6	1,999.0	2,000.1
Commercial	942.2	1,000.2	1,140.0	1,214.6	1,201.5	1,251.2
Residential	950.0	1,024.2	1,159.2	1,237.0	1,176.1	1,229.8
Agriculture	459.2	489.7	503.2	511.7	530.0	530.1
U.S. Territories	34.1	41.1	47.3	60.5	62.3	57.7
Total Emissions	**6,098.7**	**6,463.3**	**7,008.2**	**7,108.6**	**7,051.1**	**7,150.1**

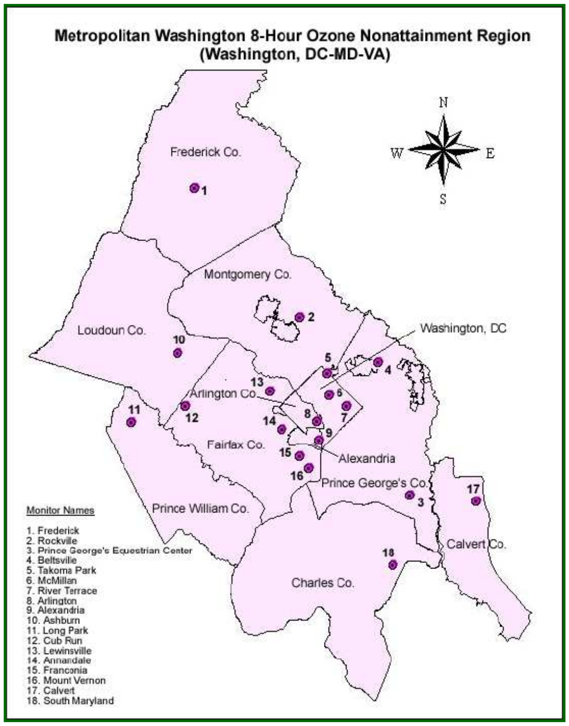


Automobile exhaust particulates are linked to air pollution and smog which in turn results in poor air quality and a degraded environment in which to live. The American Lung Association has determined a link between ozone levels and respiratory illness including asthma in resident populations.[3]

[2] Fast Facts – Inventory of US Greenhouse Gas Emissions and Sinks http://epa.gov/climatechange/emissions/usinventoryreport.html

[3] P.2-11, Figure 2-4, Metropolitan Washington Council of Governments (MWCOG) *State Implementation Plan, Plan to Improve Air Quality in the Washington, DC_MD-VA Region*, May 23, 2007. Data Source: American Lung Association, *State of the Air Report, 2006*. www.lungusa.org

Figure A.3: Washington DC, MD, VA 8 hour Nonattainment Region[4]



According to the US Energy Information Administration (EIA), "the United States consumes about 21 million barrels (882 million gallons) of petroleum products each day, almost half in the form of gasoline used in over 210 million motor vehicles traveling over 7 billion miles per day".[5] A GHG reduction strategy therefore must address and include a reduction of emissions from the transportation sector in order to be successful.

The US 1990 Clean Air Act Amendments introduced measurement criteria and standards. Data analyzed under this legislation resulted in the Washington DC-MD-VA region (see Figure A.3) being declared a "nonattainment zone", meaning it did not meet the requirements of the Clean Air Act in terms of ozone criteria levels. As a result a State Implementation Plan (SIP) was formulated. Loudoun County is one of the counties included in the Washington DC-MD-VA region[6] directly affected by this SIP initiative.

This is of importance to Loudoun County as it is responsible for keeping within the allotted emissions levels of ozone. As population increases with growth and development, the levels of emissions will grow exponentially unless a strategic approach to emissions is embraced. The County Energy Strategy (CES) proposes to reduce greenhouse gas emissions from transportation (and also the built environment) and will thus contribute substantially to ensuring that Loudoun County contributes to improving the Air Quality Index (AQI), by which the Clean Air Act monitors compliance. In 2007, the Metropolitan Washington DC-MD-VA region ranked 7th in the United States with 38 days where the AQI was above 100[7]. Improving the Air Quality

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4 P.2-4, Figure 2-1, Metropolitan Washington Council of Governments (MWCOG) *State Implementation Plan, Plan to Improve Air Quality in the Washington, DC_MD-VA Region*, May 23, 2007.

5 http://www.eia.doe.gov/bookshelf/brochures/gasoline/index.html

6 The Washington nonattainment includes the District of Columbia, Arlington, Fairfax, Loudoun, Prince William counties, and the cities of Alexandria, Falls Church, Fairfax, Manassas, and Manassas Park in Virginia; as well as Calvert, Charles, Frederick, Montgomery, and Prince George's counties and the Cities of Bowie, College Park, Gaithersburg, Greenbelt, Frederick, Rockville, and Takoma Park in Maryland.

7 Source: p.G-7, US Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, State Transportation Statistics, 2008. The Ranking (with number of AQI days) were:

Index will especially benefit the "population-at-risk"[8] or individuals more vulnerable to ill effects from air pollution. This includes children; asthmatics over 65; individuals with chronic respiratory diseases; and those especially sensitive to ozone.

Figure A.4: US Energy Flow Diagram with Emissions of Greenhouse 2007[9]

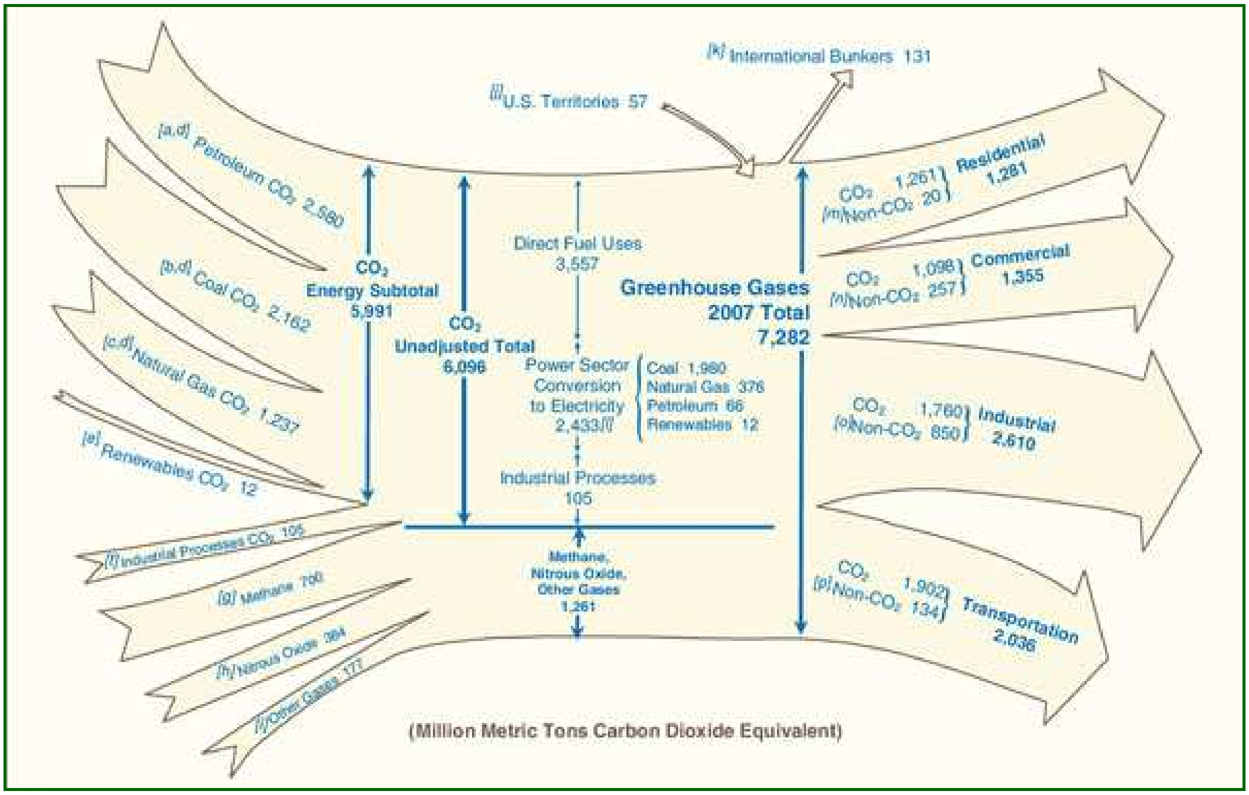


Figure A.4 illustrates the overall energy usage along with greenhouse emissions for 2007.[10]

Riverside, San Bernardino, CA (135); Los Angeles - Long Beach, CA (59); Baltimore, MD (45); Pittsburg, PA (44); Philadelphia, PA-NJ (40); and Cincinnati, OH-KY-IN (39).

[8] Source: P.2-11, Figure 2-4, Metropolitan Washington Council of Governments (MWCOG) *State Implementation Plan, Plan to Improve Air Quality in the Washington, DC_MD-VA Region*, May 23, 2007. Data Source: American Lung Association, *State of the Air Report, 2006*. www.lungusa.org

[9] Source: USA EIA, http://www.eia.doe.gov/oiaf/1605/ggrpt/flowchart.html. Report #: DOE/EIA-0573(2007); Released Date: December 3, 2008.

[10] The total GHG emissions noted of 7,282 million metric tonnes includes International Bunker fuels of 131 Tg which is typically removed in domestic analysis. When subtracted, the 7,150.1 Tg total, referenced above, remains.

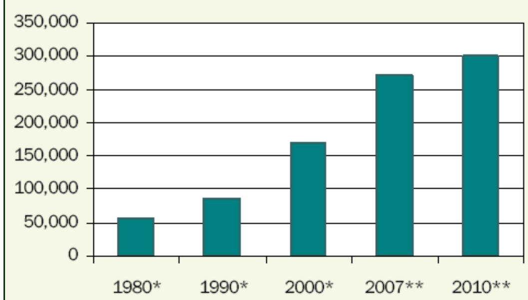
Appendix B: Profile of Loudoun County

Demographic and Economic Background

The following demographic and economic data for December 2008 is from the Monthly Indicator Reports published by the Loudoun County Department of Economic Development.[11]

Population

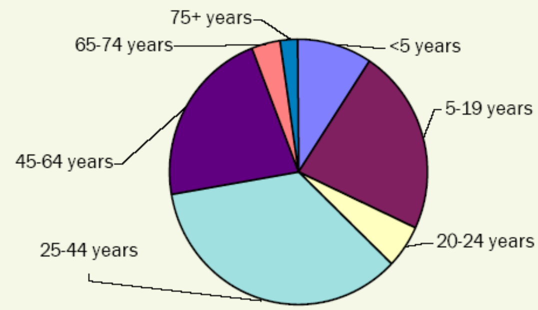
The 2007 estimated population for Loudoun, one of the fastest-growing counties in the nation since the late 1990s, is 271,069.



*Sources: *U.S. Census Bureau, **2007 Loudoun County Fiscal Impact Committee*

2007 Age Characteristics

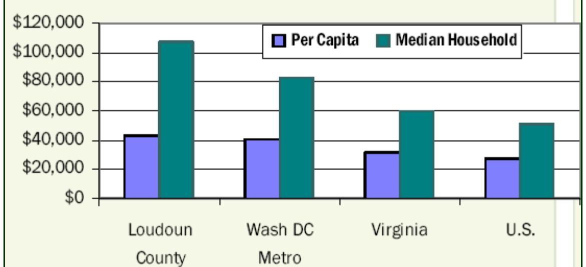
With 56.9% of the population between 25 to 64, Loudoun has a young and abundant workforce.



Source: U.S. Census Bureau, 2007 Time Series Estimates.

2007 Income Comparison

The median household income in Loudoun, $107,207, is more than double the national median of $50,740.



Sources U.S. Bureau of the Census, American Community Survey, 2007

Major Employers

The following is a select list of Loudoun's largest employers. A complete list of major employers is available online at http://biz.loudoun.gov.

Company	Employment Range
AOL LLC	1,000–4,999
Department of Homeland Security	1,000–4,999
Loudoun Hospital Center	1,000–4,999
M. C. Dean, Inc.	1,000–4,999
Orbital Sciences Corporation	1,000–4,999
United Airlines, Inc.	1,000–4,999
Verizon Business	1,000–4,999
HHMI Janelia Farm Research Campus	300–499*
Rockwell Collins Simulation	300–499
Telos Corporation	300–499

*Projected

Source: Virginia Employment Commission, 2nd Quarter 2007

[11] Source: Monthly Indicators, December 2008
http://biz.loudoun.gov/Home/FactsStatsandMaps/Publications/EconomicIndicators/tabid/192/Default.aspx

Population Growth – 2000 to 2040

Loudoun County grew by approximately 100,000 residents between 2000 and 2005, with a high rate of growth forecast to continue well into the future. This rate of growth may be tempered in the short term as a result of current (2009) overall North American economic conditions, substantial growth is still anticipated to 2030, the target period of this report. By 2030, the population is expected to increase by over 184% or an additional 300,000 people with a commensurate growth in number of households of an additional 100,000. Employment is expected to grow by 198%, adding over 200,000 jobs. Further increases are projected between 2030 and 2040.

Live / Work Ratio

An important statistic, especially from multiple energy perspectives is the live / work ratio. The Live/Work changes from a ratio of 1.9 residents per job in 2007 to 1.5:1 in 2040.[12] "Improving the jobs/housing balance reduces trip length and overall travel, particularly in peak periods."[13]

Automobile Transportation

Figure B.1 illustrates the travel profile of residents of Loudoun County. It illustrates that 86% commute to work alone by car with an additional 10% opting to carpool. In Loudoun County, 96% of trips to work depend upon passenger automobiles. This is higher than the US national benchmark of 76% shown in Figure B.2 and reveals the County's very heavy reliance on passenger automobiles for mobility.

Figure B.1: Loudoun County Commuter Modal Preference, 2008[14]

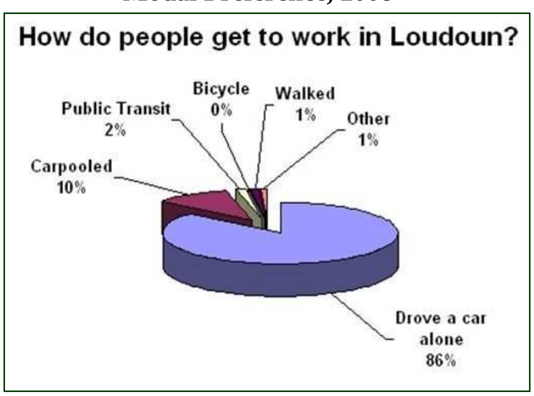
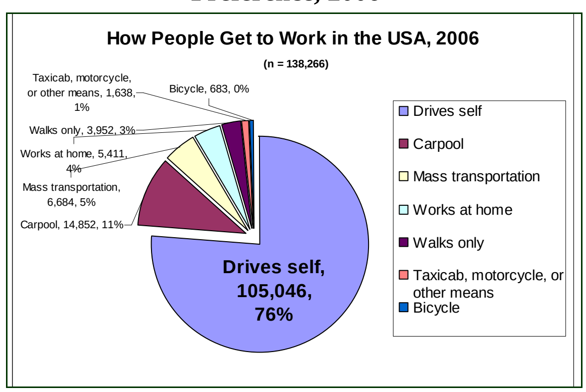


Figure B.2: US National Commuter Modal Preference, 2006[15]



[12] Annual Employment Trends and Forecasts, 2000 - 2040: Loudoun County Government, Department of Management and Financial Services, October 2008.

[13] Western Loudoun Transportation Planning Meeting, Held August 29, 2007 at the Lucketts Community Center

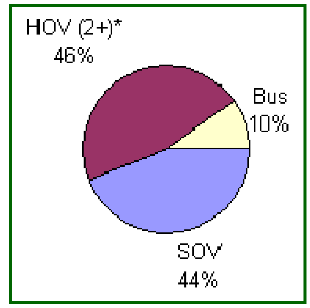
[14] http://greenerloudoun.wordpress.com/2008/02/12/how-do-we-get-out-of-our-cars/

[15] Table A-20: How People Get to Work: 2006 – USA National Statistics http://www.bts.gov/publications/transportation_statistics_annual_report/2007/excel/table_a_20.xls Data Source: US Department of Commerce, US Census Bureau, American Community Survey (Washington, DC: Annual issues), available at http://www.census.gov/acs/www/index.html; as of September 2007.

Within the Metropolitan Washington DC-MD-VA region a survey of mode share in 2001 in the I-395 Corridor at the Beltway Corridor between 6:30 and 9:30 AM indicated that 46% of commuters were using the High Occupancy Vehicle (HOV) lanes (2 or more people) and that 10% were opting for the bus during the busy morning rush hour period (see Figure B.3).

Loudoun County is focusing on efforts to reduce single passenger vehicle to reduce the ever growing congestion on the main transit routes. This will be to encourage the use of mass transit and "active" modes of transportation such as cycling or walking.

Figure B.3: 2001 I-395 Mode Share during AM Commute[16]



Vehicle Fleet

Figure B.4 shows the vehicle count by type and Figure B.5 by age. Approximately 50% of the vehicles are 6 years old or less. The 2007 median age[17] for cars is 9.2 years, and for light trucks is 7.1 years.

Figure B.4: Vehicle Count by Type 2009

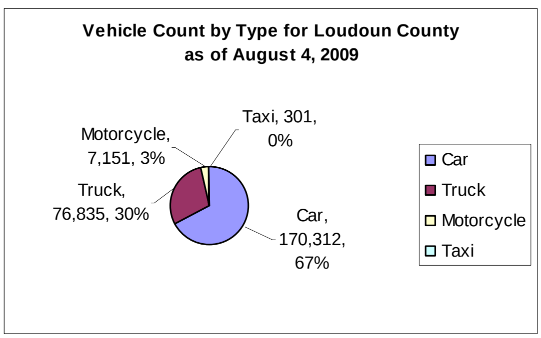
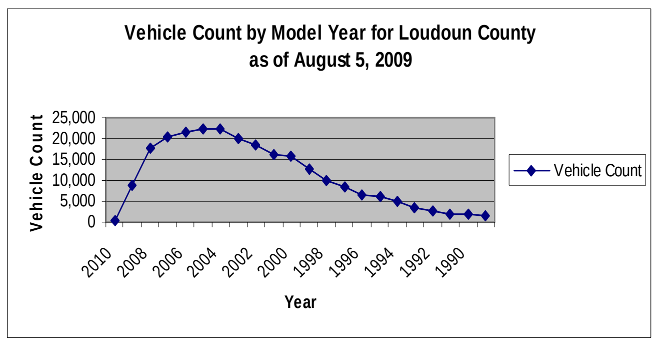


Figure B.5: Vehicle Aging, 2009



A survey of 2008 vehicle registrations in the Metropolitan Washington DC-MD-VA region indicates that the number of hybrids has grown most in Virginia (see Figure B.6). When not being driven to school by parents, or driving themselves if of driving age with a car, students are transported to school by school buses. In addition to these fleets, Loudoun also has its own County maintenance and service vehicle fleet (see Figure B.7).

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16 http://www.thinkoutsidethecar.org/transit/hov_use/mode_share.htm

17 p.3-12, Median Age of Cars and Trucks in Use, 1970 – 2007 (years). US DOE, Energy Efficiency and Renewable Energy, *Transportation Energy Data Book*

Figure B.6: 2008 Vehicle Registration Data – Comparison of Hybrids[18]

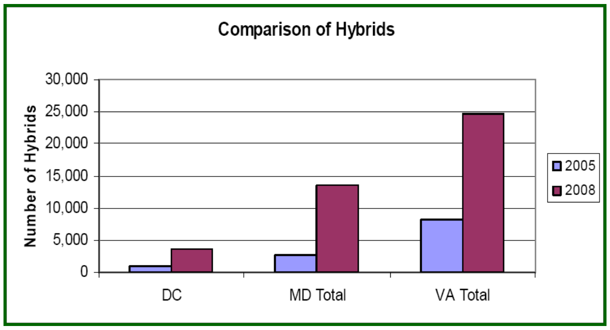
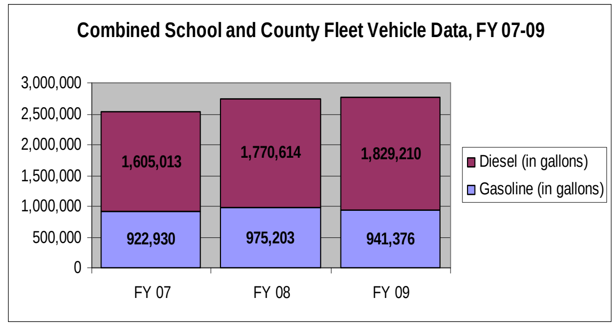


Figure B.7: Combined School and County Fleet Vehicle Data, for fiscal years 2007 – 2009[19]



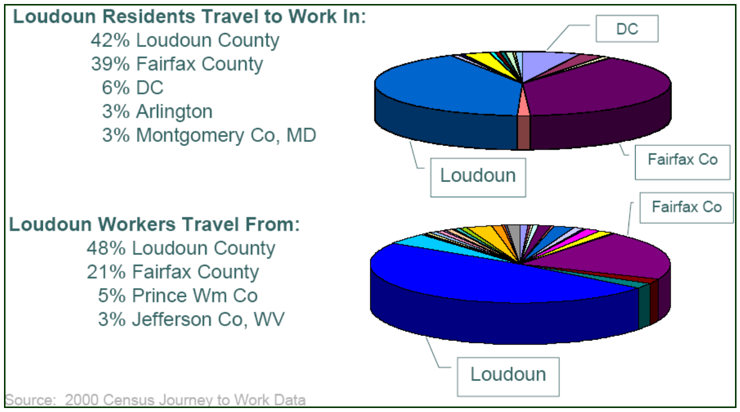
Commute Patterns

The three largest residential areas[20] are Ashburn, Sterling and Leesburg. The largest employment center in the County is Dulles. While residents are increasingly employed in the Loudoun County at companies like AOL and Verizon, a large percentage of residents continue to rely on employment outside the jurisdiction. "Recent data on county employees illustrate that the percentage of employees residing in the County is steadily declining and was down to 53% in 2007. As just one example, 33% of school district employees commute to Loudoun from other counties. This trend is consistent with Census data from 1990 and 2000 for all county employment".[21] Many people employed in the County seek more affordable housing outside the jurisdiction's boundaries and then must reverse commute to work.

The 2007 income comparison provides an indication of the affluence of the Loudoun County region. Providing adequate levels of affordable housing is a challenge given this relative affluence. However, it is recognized as a necessary criterion to establish a more equal job to housing balance. Reduced energy is an important dimension of affordability for residents.

[18] 2008 Vehicle Registration Data, Travel Management Subcommittee (TMS) March 24, 2009, Item #3.
[19] Loudoun County
[20] as measured by zip codes . Loudoun County.
[21] *Western Loudoun Transportation Planning Meeting*, Held August 29, 2007 at the Lucketts Community Center

Figure B.8: Loudoun Travel Patterns To and From Work[22]



Analysis of the demographic and employment data for 2007 results in a calculated live/work ratio of 3.88:1 (21,069:5,429). As Loudoun's transportation network increased the connectivity with employment in the Washington DC-MD-VA area, the residential population is skewed to the eastern section of the County. The commuting nature of County residents for 2000 is captured in Figure B.8. The Loudoun County Transit Plan notes that these percentages have changed little since 1990[23].

According to the Loudoun County-wide Transport Plan (CTP) update through-trips[24] (defined as long-distance commuters from areas west of Loudoun County travel through the County to reach capital region employers) account for approximately 11% of all vehicle trips. Over 30% of Vehicle Miles Traveled (VMT) in the County are of a longer average trip length (>55 miles) than trips starting or ending in Loudoun County. These were 14.3 miles on average in 2000 (for travelers whose trip started and/or ended within Loudoun County)[25].

The anticipated[26] growth in population and employment in western Loudoun County is projected to produce an even greater increase in travel. While the primary residential growth in western Loudoun County will contribute to longer trip lengths and increased miles of travel, there are some indications in the travel projections that travel increases will be somewhat offset by improved balance of jobs and housing in eastern Loudoun County.

[22] *Loudoun Countywide Transportation Plan Update*, 2000 Census Journey to Work Data www. loudoun ctp.com/.../CTP%20Update_112706_revised.pdf.

[23] p.3. *Loudoun County Countywide Transportation Plan Update*, Technical Memorandum #1, Existing Conditions and Initial Alternatives. February, 2007.

[24] P. 4 *Loudoun County Countywide Transportation Plan Update*, Technical Memorandum #1, Existing Conditions and Initial Alternatives, February, 2007 and *Loudoun Countywide Transportation Plan Update*, 2000 Census Journey to Work Data www. loudoun ctp.com/.../CTP%20Update_112706_revised.pdf

[25] *Loudoun Countywide Transportation Plan Update*, 2000 Census Journey to Work Data www. loudoun ctp.com/.../CTP%20Update_112706_revised.pdf

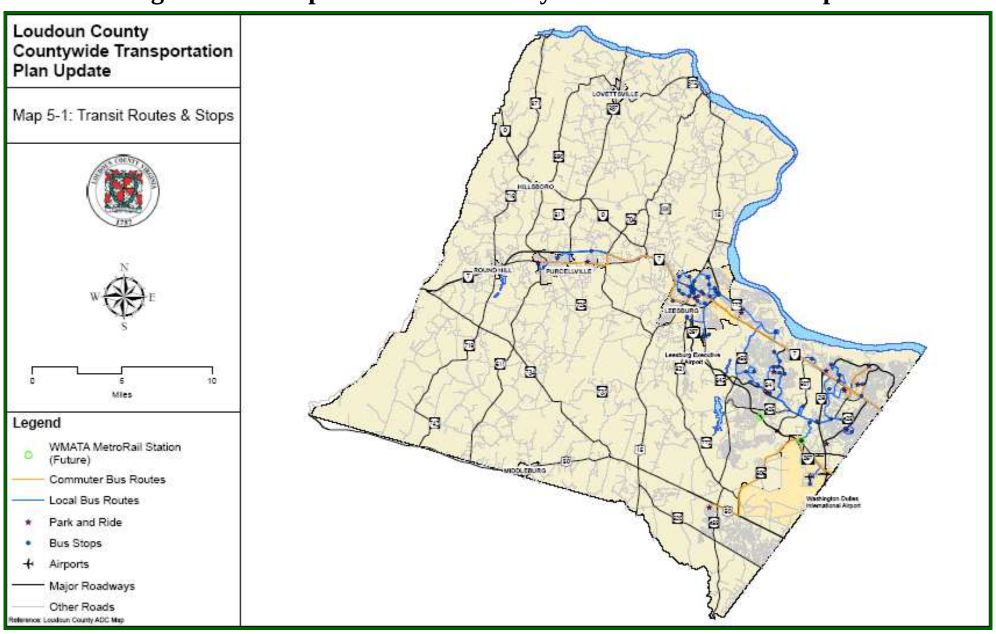
[26] p.10. Loudoun County Countywide Transportation Plan Update, Technical Memorandum #1, Existing Conditions and Initial Alternatives. February, 2007. Also, Michael Baker Jr, Inc. reports and efforts in preparing Loudoun's County Transit Plan.

Based on Loudoun's transportation forecasting demand model[27], vehicle miles traveled (VMT) will increase by 223% by 2030, with the average trip length increasing 1.7 miles or 12%. Total vehicle trips are expected to increase by 176%. Vehicle trips are projected to increase by a lower rate than the anticipated population and employment increases noted in the previous section. This finding implies that the increased balance of jobs and housing in eastern Loudoun County has the potential to offset some of the growth in travel by facilitating more "internal capture" trips within each transportation area zone (TAZ). These trips would be shorter in length and/or could shift to non-vehicle modes such as walking.

Public Bus Transportation

Figure B.9 maps Loudoun County's transit routes and stops. Public transportation is a very distant second method of mobility within Loudoun County with only 2% commuting to work using public transit. However, public transit is a growing and vital component of an improved community mobility strategy.

Figure B.9: Map of Loudoun County Transit Routes and Stops[28]



A recent study states "increased transit service combined with operational efficiencies and land use development can reduce greenhouse gases by 24 percent." Further, "vehicle cost savings of these strategies exceed the cost of implementation by as much as $112 billion."[29]

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[27] *Loudoun Countywide Transportation Plan Update*, 2000 Census Journey to Work Data www. loudoun ctp.com/.../CTP%20Update_112706_revised.pdf. And also p.10. Loudoun County Countywide Transportation Plan Update, Technical Memorandum #1, Existing Conditions and Initial Alternatives. February, 2007.

[28] Source: p.22. Loudoun County Countywide Transportation Plan Update, Technical Memorandum #1, Existing Conditions and Initial Alternatives. February, 2007.

Two main types of transit service are available within Loudoun County:

1) Loudoun County Transit commuter bus service ("Commuter Service") –link Loudoun residents to employers in capital regions including Pentagon, Arlington and Washington, DC. These are a direct service to and from Loudoun into DC stopping in Rosslyn and Pentagon; along Route 7 corridor connecting to MetroRail Orange Line at West Falls Church; and the Reverse Commute service from West Falls Church to employer sites in Loudoun. Service levels in 2007 included 31 buses, 87 daily runs, and 1,700 park and ride spaces with ridership exceeding 2,800 daily passenger trips. Transit ridership on commuter bus routes equals 0.4% of vehicle trips. Commuter Bus Monthly Ridership30 is detailed in Figure B.10.

2) Virginia Regional Transportation Association (VRTA) Local Transit Service – 9 circulator routes with total 2006 daily ridership exceeding 1,000. Fixed Route Daily Ridership[31] is detailed in Figure B.11 shown below.

Figure B.10: Commuter Bus Monthly Ridership[32]

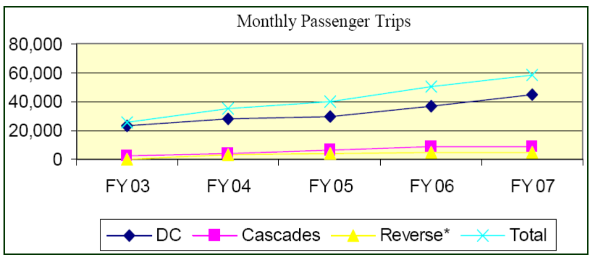
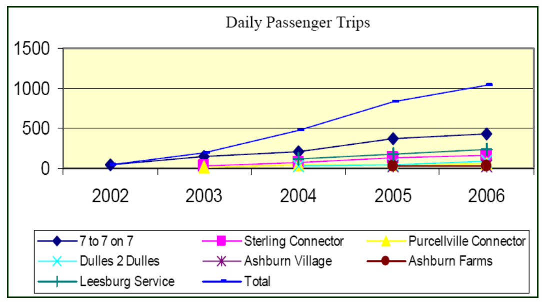


Figure B.11: Fixed Route Daily Ridership[33]



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[29] Study Emphasizes Benefits of Leaving Car at Home and Using Public Transit, released Thursday, July 30, 2009. Sponsored by organizations such as the Federal Highway Administration, the American Public Transportation Association and the Environmental Protection Agency, Article available http://www.loudouncountytraffic.com/

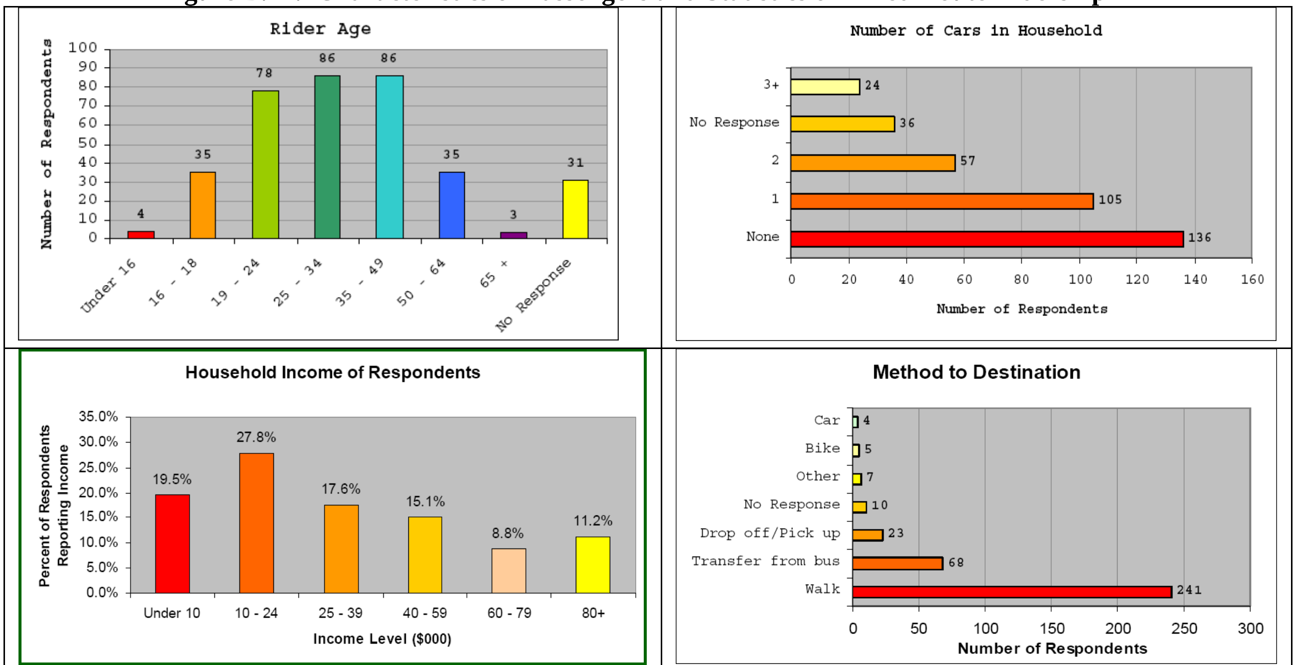
[30] p.5-6.Figures 2-1 and 2-2. Loudoun County Countywide Transportation Plan Update, Technical Memorandum #1, Existing Conditions and Initial Alternatives. February, 2007.
And *Loudoun Countywide Transportation Plan Update*, 2000 Census Journey to Work Data www. loudoun ctp.com/.../CTP%20Update_112706_revised.pdf

[31] p.5-6.Figures 2-1 and 2-2. Loudoun County Countywide Transportation Plan Update, Technical Memorandum #1, Existing Conditions and Initial Alternatives. February, 2007.
And *Loudoun Countywide Transportation Plan Update*, 2000 Census Journey to Work Data www. loudoun ctp.com/.../CTP%20Update_112706_revised.pdf

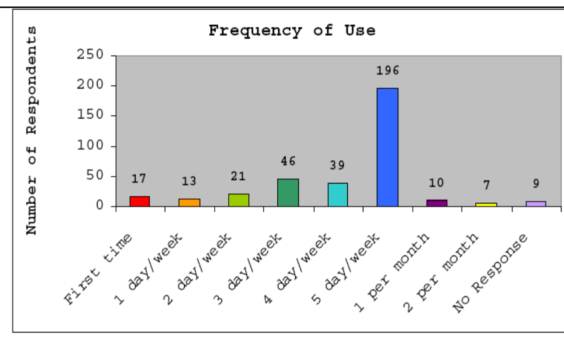
[32] p.5-6.Figures 2-1 and 2-2. Loudoun County Countywide Transportation Plan Update, Technical Memorandum #1, Existing Conditions and Initial Alternatives. February, 2007.
And *Loudoun Countywide Transportation Plan Update*, 2000 Census Journey to Work Data www. loudoun ctp.com/.../CTP%20Update_112706_revised.pdf

[33] p.5-6.Figures 2-1 and 2-2. Loudoun County Countywide Transportation Plan Update, Technical Memorandum #1, Existing Conditions and Initial Alternatives. February, 2007.
And *Loudoun Countywide Transportation Plan Update*, 2000 Census Journey to Work Data www. loudoun ctp.com/.../CTP%20Update_112706_revised.pdf

Figure B.12: Characteristics of Passengers and Statistics on Fixed Route Ridership[34]



Location	Trip Origin	Trip Destination
Work	20%	39%
Home	60%	23%
Shopping	5%	12%
Social/Personal	4%	9%
Medical	3%	6%
School	2%	6%
No Response	4%	4%
Other	2%	1%



MetroRail

Inter-county commuters are currently served by the MetroRail service. The 2020 Plan notes an increase in line miles for both light rail (33 new line miles by 2020) and MetroRail (increased to 83 line miles by 2020)[35]. The enhanced Dulles Metrorail will permanently connect Northern Virginia to the rest of the region, beginning in DC and following the Orange Line through Arlington County, extending through Tysons Corner, Reston, Herndon, Dulles International Airport and continuing into Loudoun County. Northern Virginia will have unprecedented access through the region and for Loudoun's citizens.

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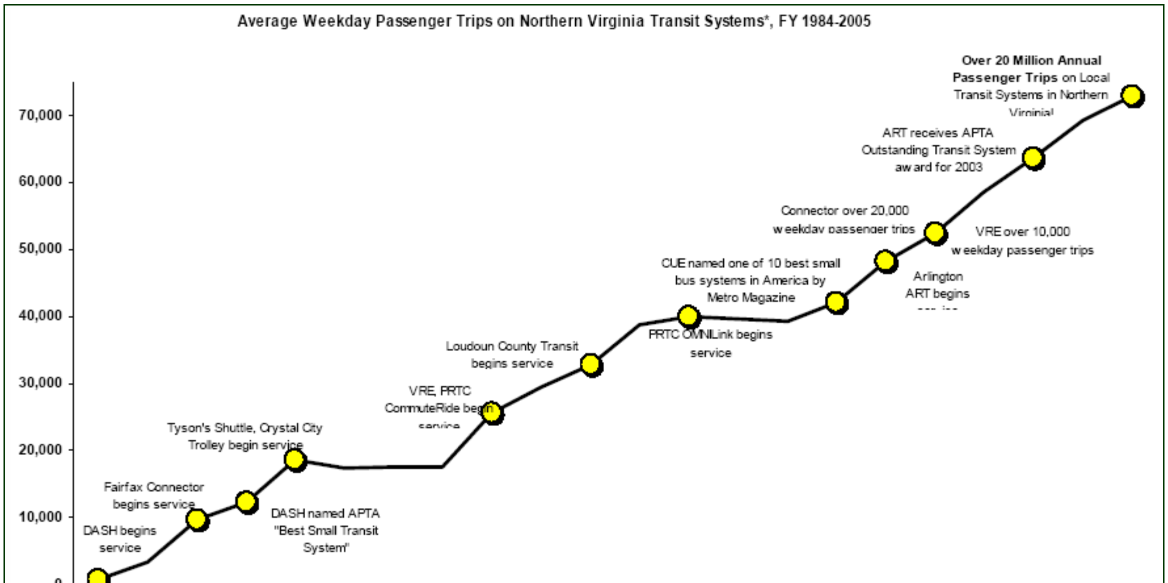
[34] Michael Baker Jr., Inc. *Loudoun County Transit Plan, Fixed Route Bus Survey Results*, May 27, 2008. www.**loudouncounty**transitplan.com/.../Fixed%20Route%20Survey%20Summary.pdf

[35] p.19, *2020 Plan*

Currently, approximately 25% of park-and-ride vehicles at MetroRail stations in Fairfax (Herndon-Monroe, Reston North and Reston East), belong to residents of Loudoun.[36] Ridership on the MetroRail system has increased steadily between the years of 1984 – 2005[37].

Figure B.13: Evolution of MetroRail Ridership[38]



	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Trips	753	3,254	9,619	12,231	18,696	17,433	17,605	17,605	25,681	29,495	32,886	38,743	40,052	39,740	39,411	42,100	48,236	52,539	58,615	63,827	69,338	73,145

* Northern Virginia Transit Systems for 2004 include DASH, Fairfax Connector, CUE, VRE, PRTC OmniRide and OmniLink, Loudoun County Transit, and Arlington Transit (ART). Previous years may include data from RIBS, Tyson's Shuttle, Crystal City Shuttle, and Loudoun County Commuter Service. WMATA MetroRail and MetroBus data not included. CUE began service in FY 81.

The 2020 Plan developed by Virginia's Department of Transportation (VDOT) envisions a multi-modal transportation system, incorporating rail, roadway, bus, air, water, pedestrian and bicycle facilities into an interconnected network and that supports Northern Virginia's economy and quality of life.[39]

Public Opinion Survey highlights the desire by current residents for an alternative to personal vehicles for transportation options (see Figure B.14).

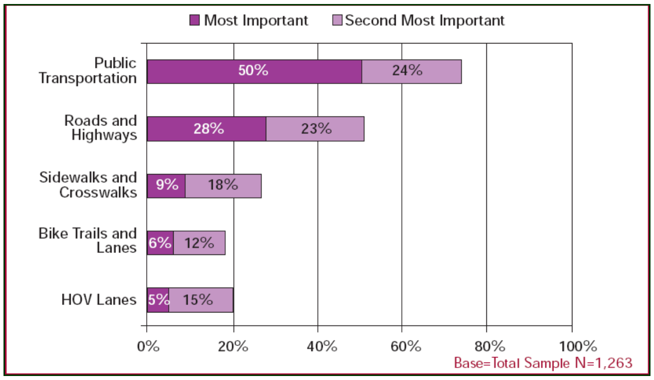
[36] *Loudoun Countywide Transportation Plan Update*, 2000 Census Journey to Work Data www. loudoun ctp.com/.../CTP%20Update_112706_revised.pdf

[37] *Loudoun Countywide Transportation Plan Update*, 2000 Census Journey to Work Data www. loudoun ctp.com/.../CTP%20Update_112706_revised.pdf

[38] *Northern Virginia 2020 Transportation Plan, Improvements for short, medium and long-term transportation needs* http://virginiadot.org/projects/northernvirginia/northern_virginia_2020_transportation_plan.asp

[39] p.7. *Northern Virginia 2020 Transportation Plan, Improvements for short, medium and long-term transportation needs* http://virginiadot.org/projects/northernvirginia/northern_virginia_2020_transportation_plan.asp

Figure B.14: Public Opinion Survey of Desired Transportation Improvements[40]



Enhanced bus service is proposed in the County Transit Plan. Currently, public transportation options are limited for travel beyond the county's borders where most residents' jobs are located. However, the MetroRail expansions will serve future development.

Figure B.15: MetroRail Expansion Project

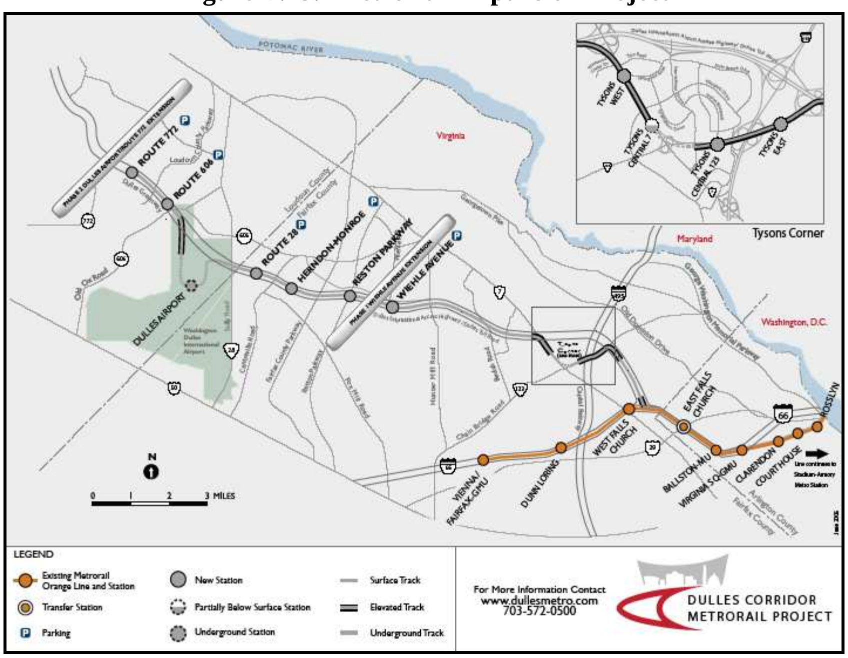


Figure B.15 shows the two phases of the MetroRail expansion[41]. Phase 1 is under construction and projected to open in 2013. It will add 4 stations extending the Metrorail to Wiehle Avenue at the eastern edge of Reston and connecting Tysons Corner. Phase 2, due to open in 2016, will

[40] p.4. Northern Virginia Transportation Authority (NVTA), *Trans Action 2030: Transportation for Today and Tomorrow. Summary Report*, January 2006.
[41] http://www.dullesmetro.com/stations/ryan.cfm

have six stations – Reston Parkway, Herndon-Monroe, Route 28, Dulles Airport, Route 606[42] and Route 772[43] - extending it through Reston and Herndon to Dulles Airport and into Loudoun County."[44] Two new MetroRail stops will be located within Loudoun County. These are Route 772 and Route 606, both noted as Excess Demand and Travel Reduction Opportunity Areas[45].

Climate

Both energy use and potential renewable energy production are closely linked to the local climate, and of course, the CES, is based on Loudoun County's climate.

Heating and Cooling Degree Days

A major component affecting building energy use is the need for heating and cooling, obviously, and is impacted by the seasonal weather conditions. Heating and cooling degree days are a general indicator of the degree to which buildings need heating or cooling to maintain a specified level of temperature comfort.

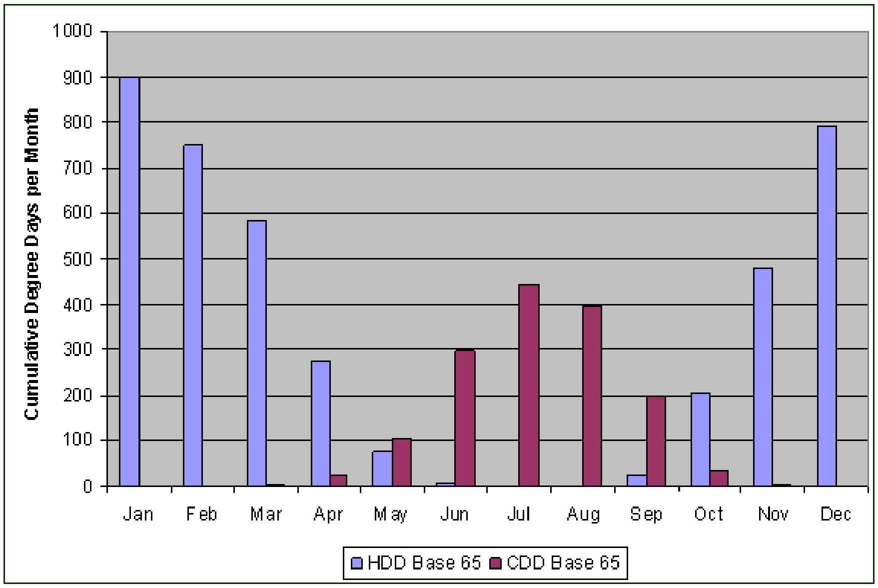
Loudoun County has a climate that requires significant heating and cooling, with heating being the greater demand. The annual average heating climate indicator is 4,096 heating degree days (referenced to an average outdoor temperature of 65 degrees Fahrenheit)[46] which indicates a fair amount of heating needs. By comparison, Mannheim, located in southern Germany, has about 3,470 heating degree days, while Columbus, Ohio has about 5,500.

Cooling degree days average 1,509 (referenced to an average outdoor temperature of 65 degrees Fahrenheit).[47] The use of air conditioning and its cooling load is significant and must be addressed in energy planning. A summary of both heating and cooling degree days by month as an indicator of climate is shown in Figure B.16.

[42] Route 606 details: Ground level station located west of the intersection of the Dulles Greenway and Route 606. Station facilities to include: 1 station entrance on north side of Dulles Greenway, Pedestrian bridge crossing Dulles Greenway, Bus drop-off/pickup, Kiss & Ride, Parking for 2,750 cars (includes existing 750 spaces at Dulles North Transit Center). Trains are anticipated to run every seven minutes in the peak period (rush hours) and less frequently in the off peak.
[43] Route 772 details: Ground level station located at the intersection of the Dulles Greenway and Route 772 (Ryan Road). Station facilities to include: 2 station entrances (both sides of Dulles Greenway), Pedestrian bridge crossing Dulles Greenway, Bus drop-off/pickup (both sides), Kiss & Ride (both sides), Parking for 3,300 cars (1,650 on each side). Trains are anticipated to run every seven minutes in the peak period (rush hours) and less frequently in the off peak.
[44] http://www.dullesmetro.com/stations/
[45] Loudoun CTP Update, 3_29_07_TLUC_Presentation_Revised.pdf

[46] Garforth International Team
[47] Garforth International Team

Figure B.16: Monthly Heating and Cooling Degree Days in Loudoun County Area

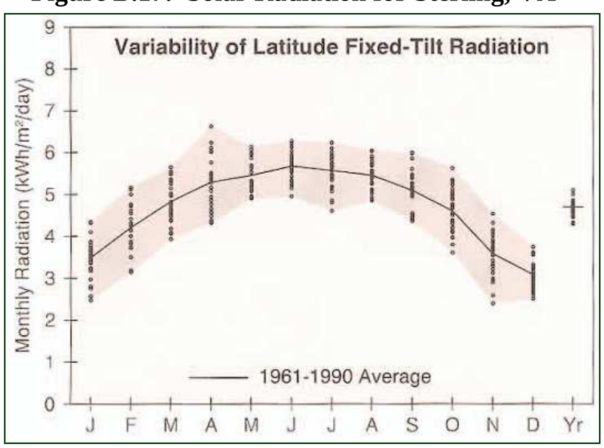


For building energy modeling, the eQuest[48] analytical program was used for residential and commercial buildings. Washington, D.C. was the closest available source for eQuest climate information, so it was used as the basis for hourly simulations.

Solar Resources

The solar potential for electricity and solar heating is between 4 and 6 kilowatt hours per square meter [49] depending on orientation and type of the collector.

Figure B.17: Solar Radiation for Sterling, VA[50]



[48]Freeware from DOE Site http://www.doe2.com/
[49] National Renewable Energy Laboratory, http://www.nrel.gov/docs/fy08osti/42463.pdf
[50] NREL Solar Radiation Data for WBAN 93738 Sterling, VA

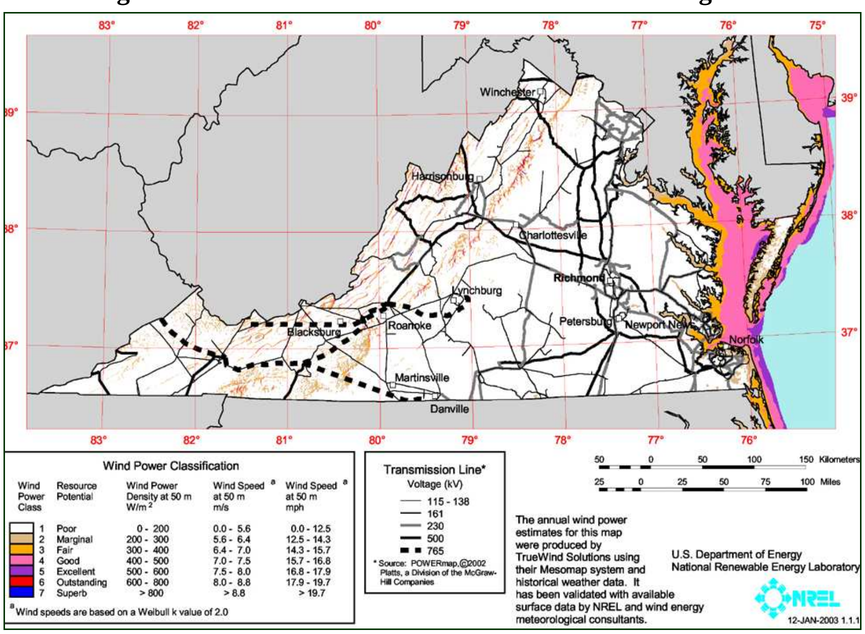
The annual solar electricity potential for photovoltaic (PV) is a viable option in Northern Virginia. For example, using the National Renewable Energy Laboratory PV Watt tool[51], a 4 kW system in Sterling with average solar radiation of 4.7 kWh/m2 would generate 4,928 annual kWh. Under potential incentives, solar PV can be attractive both for large scale solar installations, and for small scale roof-top installations. An assessment[52] of the potential for rooftop solar power in the Route 28 commercial and industrial corridor indicates that over 15 million square feet of flat roof is currently available for buildings larger than 5,000 square feet.

In the case of solar thermal applications, the likelihood of solar heating being a significant energy contributor is relatively low at the community level, but could be a consideration on a project basis where the building is unlikely to be connected to a district heating network.

Wind Resources

Figure B.18 is a wind map for Virginia. Wind quality for power generation in Loudoun County is less attractive than in other regions like coastal/offshore areas and the Shenandoah Valley. However, wind as a potential electricity source that should be regularly reviewed in the context of available incentives and advances in technology. In any case, wind generators are visible symbols of commitment t alternative energy and may have value for that reason alone.

Figure B.18: 50 Meter Wind Power Resource for Virginia[53]



51 http://rredc.nrel.gov/solar/codes_algs/PVWATTS/version1/US/Virginia/Sterling.html
52 http://www.pecva.org/anx/ass/library/19/energy_rt28_buildings.pdf
53 NREL http://www.windpoweringamerica.gov/images/windmaps/va_50m_800.jpg

Crossroads in Development

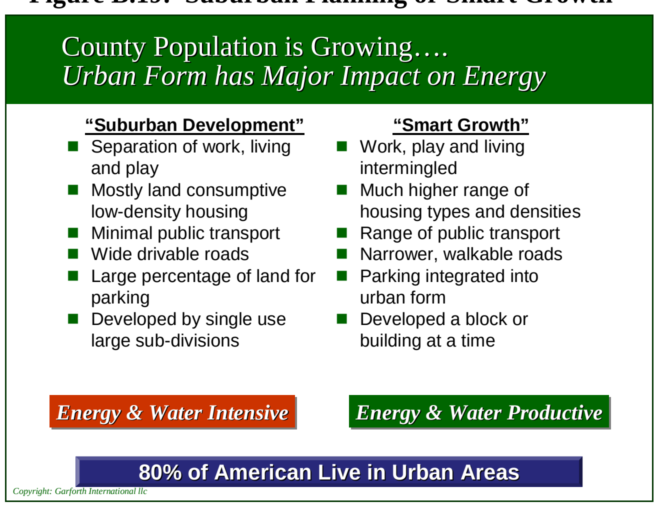
Land-use planning and development in North America in the post-war era has tended to create suburban sprawl ringing urban centers. Continuing this traditional planning regime or along this business-as-usual ("BAU") path will amplify the suburban sprawl that has been created. This resultant development has created an energy intensive landscape. In the case of an area like Loudoun County, this form of development also erodes the attractive rural nature of much of County.

There are alternatives. One that contrasts the traditional approach and breaks away from the BAU path is "Smart Growth" and many communities are now embracing its ten core principles[54]:

1. Create mixed land uses
2. Take advantage of compact building design
3. Create a range of housing opportunities and choices
4. Create walkable neighborhoods
5. Foster distinctive, attractive communities with a strong sense of place
6. Preserve open space, farmland, natural beauty, and critical environmental areas
7. Strengthen and direct development towards existing communities
8. Provide a variety of transportation choices
9. Make development decisions predictable, fair and cost effective
10. Encourage community and stakeholder collaboration in development decisions

Smart Growth is focused on developing thriving, mixed use, walkable neighborhoods, at somewhat higher densities rather than traditional low density automobile-dependent single-use developments. Figure B.19 compares a BAU suburban approach with "Smart Growth".

Figure B.19: Suburban Planning or Smart Growth[55]



[54] P.ii, Smart Growth Network, Getting to Smart Growth: 100 Policies for Implementation. http://smartgrowth.org
[55] Garforth International llc – adapted from various sources

Loudoun County likely development will be a mix of the two in the Eastern parts of the County, with also very low-density rural development continuing elsewhere.

Smart Growth is a major factor in developing more sustainable communities. More compact walkable communities are intrinsically less energy intensive. The emerging revised land-use planning approach to which Loudoun County is already committing, will contribute to lowered energy use and greenhouse gas emissions on a per capita basis. Working in conjunction with other CES strategies, this will be part of the way Loudoun County meets its ambitious energy targets.

Sustainable Development

Energy planning is an important component of a sustainable growth strategy. Even with the major increase in employment in the County, by 2040 the energy use and associated greenhouse gas emissions for each resident from all uses of energy including transportation will be significantly less in absolute terms than today, and vastly less than what they would have been without the CES.

Quality of Life

Energy planning seeks to lower greenhouse gas emissions through more efficient and effective energy use and supply, more energy efficient built infrastructure, and land use design promoting walkable communities and more compact neighborhoods. Increasing the use of public transit lowers the prevalence of, dominance of, and reliance on automobiles as the primary mode of transportation.

The resulting lowered greenhouse gas emissions will result in less air pollution and healthier air to breath. Increasing physical activity through “active transportation” (walking, bicycle riding, etc.) will increase fitness levels and decrease incidents of lifestyle diseases such as diabetes and obesity. Offering a wider range of transportation options and modes will increase the mobility of non-drivers (those under 16, the elderly and those with physical challenges that prevent them from driving) and will create healthier walkable neighborhoods. In short, the vision of the County Energy Strategy is consistent with the County’s quality of life goals and will help to achieve them.

Long-term Competitiveness

The County has very aggressive employment targets and the CES will be a key element to support these targets.

Energy services would be structured to offer flexible multi-utility services for commercial and industrial investors. At a minimum these would include district heating, electricity, and natural gas where needed. Depending on the needs of specific investors or the targeting of the County’s economic development plan, additional centrally supplied utilities may be added. These could include process steam, chilled water and potentially even less traditional services such as compressed air.

The CES models suggest a mix of distributed energy including centrally managed boilers, gas turbines, steam turbines and both fossil and renewable heat sources. These facilities would be scaled up over time as demand grows. The use of district heating makes substantial recovery of waste heat from both industrial and commercial processes possible, improving both overall economic and environmental performance.

The fact that Loudoun will be a role model for implementing a County Energy Strategy will not be wasted on potential investors from the Green Energy industry itself. There is likely to be a natural synergy between the County's energy philosophy and the kind of industries and businesses it attracts.

Another competitive edge for employment is the development of future university campuses and adjacent lands that can become an incubator for business and employment growth. As both a cogeneration node for district heating and electricity production as well as an educational platform for careers in sustainability, sustainability campuses can make the County an attractive location to live, work and study.

The borders of the employment corridor will be designed to seamlessly blend with the mixed-use neighborhoods. This encourages people to live in walkable or bike-able distances from work. It also will encourage the ultimate integration of the multi-utility services to further increase overall efficiency and choices of environmentally efficient energy sources. Considering extensive bridging the planned highway is recommended to avoid abrupt separation between the different parts of the County's life.

Lastly, the creation of a technically flexible, efficient energy supply including district heating for most of the County, will ensure that energy will be reliably available at consistently competitive prices for the County's homes and buildings.

Community Response to the Energy Challenge of Growth

Managing the energy and carbon footprint of the municipality for continuous and aggressive improvement has to become a way of life for the County. The CES will be a framework establishing the direction, targets and some of the early Scale Projects that will launch the County towards breakthrough energy and climate performance. These are necessary first steps, but successful execution also will require sustained civic leadership and engaging the community every step of the way.

Communities that have breakthrough energy performance achieve it by taking many actions along the entire energy chain from the choice of energy source to the efficiency of use. Done as part of a well thought out long-term strategy that is systematically implemented, these mutually support each other, such that the total energy performance is greater than the sum of the parts. This is not an easy task to implement in practice since many different players need to team together to capture the overall benefits for the County. It also means the County has to constantly engage all of its residents in a lifetime dialogue around the value and benefits of sound energy management.

Appendix C: CES - Global Best Practice[56]

The notes in this Appendix have been adapted with minimum editing from a paper prepared by Garforth International llc for BC Hydro Ltd to give a general overview of the leadership and other processes that create cities with world-class energy systems and a process of continuous improvement. They should be read in that context rather than looking for the immediate applicability of one specific technology or approach to Loudoun County. For brevity most of the illustrations from the original report have been removed.

Benchmarking Community Energy Plans

Communities around the world are increasingly recognizing that energy efficiency is an important component of a community's competitiveness and its ability to attract investment, business, and to create jobs. Managing the community's energy and climate impacts is also being increasingly prioritized. Creating healthier environments leads to increased quality of life and positively impacts the community's ability to attract residents.

Given the ever-increasing use of energy world-wide, continental, national and regional policies all have a major impact on urban energy use. On a global basis, cities account for at least 70% of all energy used in homes, buildings, transportation and urban industry. In addition, the urbanization movement is increasing. World-wide, cities are home to 50% or more of the population, and in Europe and North America, this percentage is closer to 80%. Thus effective management of the urban energy footprint is increasingly a major component of the global energy and climate challenge. Action at the local level is critical.

Communities that have been successful in achieving breakthrough energy and climate performance have done so by integrating energy planning and management programs into their planning activities rather than by treating energy as a stand-alone consideration. Sometimes this integration is more the result of historical evolution and less that of a formal energy plan. Even so, these exceptional communities have built on these "accidents of history", guiding them to higher levels of performance. Excellent examples include the European cities of Mannheim, Germany and Stockholm, Sweden.

By contrast, a fully integrated energy approach can result from a conscious set of planning decisions that have been strategically implemented through consistent execution. Examples of a planned approach include Copenhagen, Denmark and Vaxjo, Sweden.

North America has experienced a very different pattern of growth in its cities, especially over the past fifty years. Lower land costs and cheaper energy has resulted in much lower densities and much higher use of personal vehicles. The economic and environmental burdens these present are raising attention and causing North American cities to embark on community energy planning processes.

Throughout North America, interest in integrated Community Energy Planning is growing. This appendix takes a look at some of the best practices from North America and Europe to highlight the common features that any successful community energy approach will need to embrace.

[56] Adapted from "Community Energy Planning - Global Best Practices". Prepared by Peter Garforth under contract to BC Hydro PowerSmart Sustainable Communities, Vancouver, British Columbia.

Conscious of the fact that more often than not, most plans fail to meet their targeted outcomes, the CES Team herein selected communities that have clearly demonstrated results. During the selection process several criteria were identified as required for successful creation and implementation of a Community Energy Plan. These include:

- **Leadership and Community Engagement** - Developing and managing a Community Energy Plan require a leadership process that is inspiring, rigorous and non-partisan, and can survive beyond the current electoral cycle.
  - Guelph, Ontario
  - Heidelberg, Baden-Wurttemberg
- **Transparency and Outreach** - Cities with effective energy management communicate results clearly and consistently to their citizens in a manner that encourages understanding and participation.
  - Stockholm, Sweden
  - Portland, Oregon
- **World-Class Energy Efficiency** - Cities with world-class energy performance have most of their existing and all of their new buildings that are at or near world-class levels of efficiency. This is often confused with having a few LEED or similarly rated “example” buildings that are at very efficient levels while the bulk of building stock is average to poor. The impact of energy efficiency in buildings should not be underestimated. In North America, homes and buildings account for about 40% of all energy use at efficiency levels that fall far below the average in the EU. In reality this best practice is mostly seen in countries, states, or provinces that have established a framework of mandatory construction and performance standards supplemented by city level actions. This city level awareness to efficient construction of homes and buildings usually spills over into efficient industrial facilities.
  - Copenhagen, Denmark
  - California Title 24
  - East Gwillimbury, Ontario
- **Efficient Conversion - Integrated Utility Approach -** Cities with breakthrough energy performance will be served by energy sources that make the most use of the primary fuel that drives them. There are two basic sources of inefficiency, and associated creation of greenhouse gases, that will typically be minimized in efficient cities. First, when electricity is generated by biomass, coal, oil, gas or uranium, more energy makes heat than electricity. In most large systems, the bulk of this is wasted at the generator. Yet even more electricity is wasted in the power lines bringing the electricity to the city’s buildings. Efficient cities are consciously structured to either eliminate this heat waste or to make use of the heat. Secondly, when buildings are heated by individual boilers and furnaces the conversion efficiency is degraded by over-sizing and sub-optimal maintenance. Efficient cities are structured to minimize this inefficiency.
  - Mannheim, Germany
  - Markham, Ontario
  - Helsinki, Finland
- **Multi-Fuel Flexibility -** Efficient cities have an infrastructure that can combine a range of primary fuels and other energy sources. This allows them to manage the unpredictability of

costs, environmental impacts and supply reliability. In North America, urban energy systems are highly dependent on one or two sources of fuel typically with large central power plants providing most electricity, and natural gas networks providing most thermal energy.

  - Sacramento, California
  - Aalborg, Denmark

- **Low-Energy Transport -** Cities with low energy and greenhouse gas footprints have a transportation system that maximizes both the transport options available and the benefits of using the lower energy options. Urban design that encourages walking and cycling is considered as much a part of the transportation strategy as any other aspect. They are characterized by a multi-modal approach, where there is convenient switching from one transport form to another in the course of a single journey or during a working day. In many cities, transportation creates less than half the greenhouse gas emissions.
  - Berlin, Germany
  - Davis, California
  - Removing the traffic signs, Netherlands

- **Magnet for Business and Academic Excellence** - Cities that consistently deliver high levels of energy and climate performance tend to be host to world-class academic programs and businesses associated with sustainable energy in one form or another. This is sometimes the result of conscious strategic targeting by the city, and sometimes the "halo effect" of a city's commitment to energy and climate performance.
  - Copenhagen, Denmark
  - Guelph and Surroundings
  - Helsinki, Finland

- **Continuous Improvement –** The constant review and updating of the targets is a unifying theme in cities that consistently deliver higher levels of energy performance,

Most examples of reasonably successful integrated urban energy solutions, for a variety of historical reasons, are drawn from European experience – generally German or Scandinavian. Both Copenhagen and Mannheim are leading examples of integrated community energy planning. Importantly, like Loudoun County, they are located in climates that demand more heating than cooling and are democracies with a high standard of living.

European Initiatives

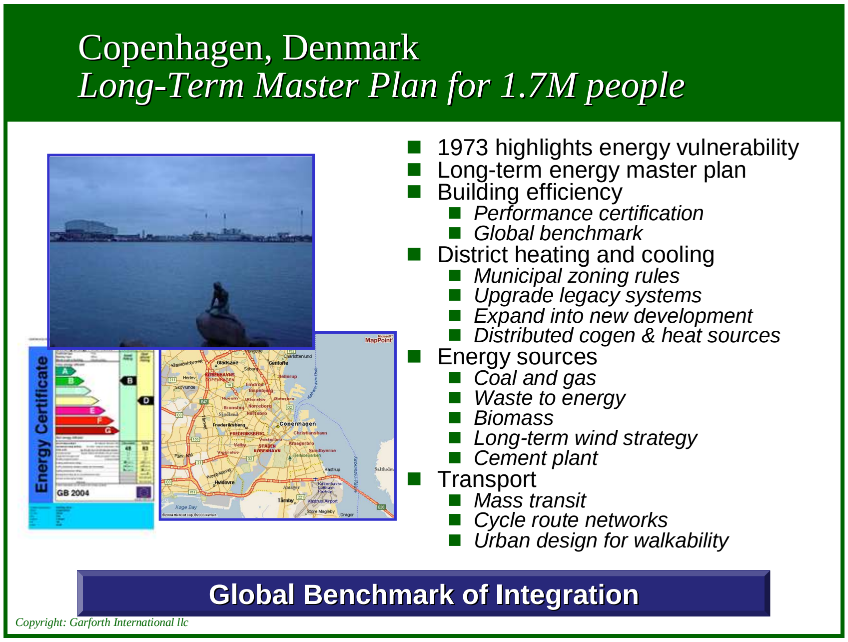
Copenhagen, Denmark

Copenhagen is aiming to be the world's Climate Capital[57]. Earlier in 2009, Copenhagen set itself the ambitious target of becoming, by 2025, the world's first CO_2 neutral capital[58]. Not content to just focus on reducing the city's own CO_2 emissions, Copenhagen is also taking on the ambitious task of leading and influencing the rest of the world. In December 2009 they will host the UN Climate Change Conference COP15, the Climate Summit for Mayors and the Children's Climate Change Forum in association with UNICEF.

[57] http://www.kk.dk/climate.aspx
[58] http://www.kk.dk/Nyheder/2009/Marts/CphToBeTheWorldsFirstC02NeutralCapital.aspx

Copenhagen is Denmark's capital and with a population in excess of 500,000 is its largest city. It is an example of global best practice when it comes to offering its residents and visitors the highest quality of life. A crucial contribution to this is Copenhagen's seamless urban planning, including architecture, public transportation, bicycle culture, harbor front, and green public spaces.

Figure C.1: Overview of Copenhagen Energy Approach[59]



During the 1973 events that led to dramatic increases in oil prices and fears of supply interruption, Copenhagen was particularly vulnerable since it was 99% dependent on imported oil and coal. This triggered multiple actions to increase the energy efficiency of buildings, use existing fuels more efficiently through the widespread use of district heating and to diversify the fuel supply through a strategic commitment to renewable energy. Today, 30 years later, Denmark through its overall policy and consistent implementation uses the least energy per unit of Gross Domestic Product (GDP) compared to any other country in the world. An overview of Copenhagen's energy approach is illustrated in Figure C.1.

[59] Garforth International llc and various sources - CEP team meetings and workshops

Figure C.2: Example of Danish Energy Performance Label (2006 Version)

Copenhagen now boasts some of the most efficient building practices in the world, and has been a pioneer in establishing approaches to guarantee and maintain the energy performance of buildings. To ensure that builders truly build to code and that users and buyers of buildings are aware of their energy performance irrespective of age, building efficiency performance standards are reviewed when built and upgraded, and then regularly reviewed, typically once every five years.

The overall contribution of a systematic approach to building codes combined with performance labeling means Denmark, and to some extent its Scandinavian and German neighbors, became the prototype for the whole of the European Union[60]. Over time the experiences pioneered in Copenhagen became the de facto standard for the 400 million inhabitants of the EU.

At the start of the planning, the city core had a communal system for delivering heating. Instead of this being closed down as has been the case in many US and Canadian cities, it was seen for the asset it was, and has been systematically upgraded and extended to cover most of the city and many of the new and remodeled suburbs. Having a thermal network to deliver space heating and domestic hot water allows vast amounts of heat traditionally wasted in the generation of electricity to be used. Most of the city's buildings and homes are served in this way. Over time, the city and surrounding low-density suburbs have become effectively zoned for heating.

A thermal network also facilitates the connection of multiple energy sources into a convenient, efficient system. The city uses a range of fuels for heat and electricity generation including coal, natural gas, oil, combustible municipal waste, wood chips, solar sources and wind. The availability of a thermal network also facilitates the optimum economic use of boilers, generators and other energy conversion equipment across the city. To further make use of the available heat from a wide range of sources, especially during the summer, district cooling is being added to the network[61].

As the city grew and redeveloped, conscious decision-making processes were put in place to minimize the use of personal cars and to maximize the use of walking, mass transit and bicycles. The details are many and all relatively well documented in many descriptions of urban planning principles. They include creating more mixed-use areas, densification of dwelling and activities, streetscape design for visual and social interest, traffic calming measures, mass transit priorities and investments, and integration of green spaces into the core urban design. Copenhagen has also been a pioneer in shared use bicycles and cars. Incidentally, these urban

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[60] See http://www.epbd-ca.org/Medias/Pdf/CA_Annex_1_Certification.pdf for a current summary of the status of Energy Performance Labeling in the EU.

[61] Heat is converted to cooling using absorption cooling technology. Many references on this are widely available.

design concepts also help create more energy efficient buildings and improve the economics of thermal energy distribution.

The community energy system is run by a consortium of neighborhood multi-utility cooperatives bound together by mutual cooperation agreements and a common dispatching system with common technical standards.

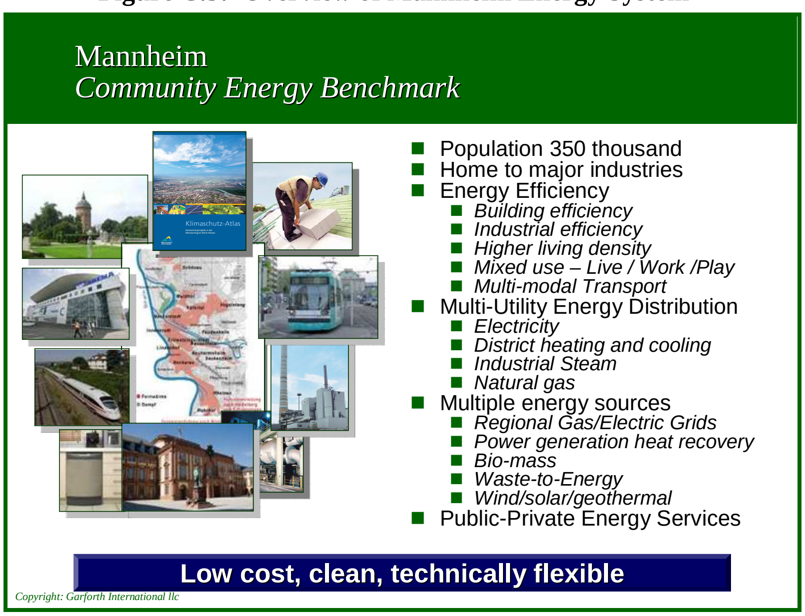
In recent years, there has been an increasing focus on rainwater recovery and reuse systems, combining the increasing deployment of so-called grey-water systems, to reuse a portion of domestic water use for non-potable applications. The main driver of this is less to conserve water in an absolute sense, but more to reduce the energy and chemicals used in water processing and transportation.

In addition to creating a highly efficient community energy system, Copenhagen and its surroundings have become a recognized center for efficient architecture, construction technologies and consulting.

Mannheim, Germany

Mannheim, Germany provides a global best practice exemplifying how sustainable development and energy efficiency, conservation, and community energy systems play together. It is a good example of an institutional approach to community energy planning that in some ways occurred as an "accident of history" but also as a result of inspired leadership.

Figure C.3: Overview of Mannheim Energy System[62]



[62] Garforth International and MVV

Mannheim is located in the Rhine-Neckar metropolitan region and its recent policy for sustainable regional development[63] is intended to include the compatible economic growth along with environmental protection. This necessitates that CO_2 emission levels be reduced in accordance with the Kyoto Protocol. In regards to energy efficiency, energy-efficient buildings and installations using energy-saving materials and components go hand-in-hand.

Like many industrialized German cities, Mannheim was heavily damaged in World War II. In the immediate post-war period, existing infrastructure, including a pre-existing district heating system and tramway system were put back into service. In the late sixties and early seventies, the combination of declining quality of domestic coal, dependency on Soviet gas and oil and Middle East oil, combined with the demands of a booming economy, put a high premium on the effective use of energy. The resulting Mannheim energy infrastructure has many similarities to Copenhagen. Homes and buildings are efficiently constructed and managed using building performance codes that are regularly updated.

Like Copenhagen, the strategic decision was made in the 1980's to upgrade and extend the district heating system, and it now extends across wide areas of the city (see Figure C.3, the red shaded areas in the map) serving the majority of both residential and commercial users with heating and domestic hot water. The city has announced in 2008 that a further 20,000 residential and commercial consumers will be added to the system in the next few years. Again, like Copenhagen, district cooling is being added to serve the downtown business district and selected specific sites, including the new SAP Arena.

A specific feature of the Mannheim structure is the creation of an industrial enterprise zone on an island in the Rhine River and its surrounding areas. This zone has a tailored energy system which supplies industrial grade steam as a community utility, in addition to supplying district heating, natural gas and electricity. As a result, investors with specific process steam needs have been attracted to this zone in efforts to avoid significant capital and operating costs.

In Mannheim, the thermal and electric networks facilitate the inclusion of multiple fuel and technology options. The bulk of the heat is sourced from a large scale coal-fired cogeneration plant located very close to the city, supplemented by natural gas, combustible municipal waste, recycled lumber from building demolition, and some solar sources.

A good example of how a flexible system such as Mannheim or Copenhagen can incorporate new technologies is the way Mannheim is piloting a trial of appliance-sized micro-cogeneration units that fit into individual homes and act as both electricity generators and heat sources.[64] If successful, this could put thousands of electricity and heat generators into the overall community system, owned and operated by the city utility.

Being a predominantly 17th century city, the core of Mannheim is essentially designed along "new urbanism" principles, and is naturally oriented more to walking, biking and mass transit. The tramway system has been radically updated in the past 15 years, and is served by frequent, air-conditioned light rail infrastructure. In parallel with upgrading the mass-transit, the city has

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[63] See http://www.klimaschutz-rhein-neckar.de/pdf/Klimaatlas_abridged_english.pdf
[64] See http://www.mvv-energie.de/cms/konzernportal/de/presse/startebene_presse/pressemeldungen/Pressedetail_7970.jsp

discouraged car use in the downtown through conveniently located central parking near mass transit, along with designating large areas of the city that are off limits to cars.

Unlike Copenhagen, the energy (electricity, gas, district heating, district cooling etc.), water and transportation supply system is run by a single municipal entity. This entity has emerged from a municipal department for energy and water supply, which was later established as a separate legal entity fully-owned by the City of Mannheim. This was one of the first German utilities to be partially privatized and converted into a private corporation - MVV Energie AG - in 1999. Its majority is still owned by the city, while other utilities and free-float investors are holding minority participations via the stock exchange.

Beyond its core business sectors of energy and water supply in Mannheim (and other cities in Germany and Czech Republic), MVV Group has developed additional business areas such as waste-to-energy and biomass plants, power trading on the liberalized European electricity market, and energy services for communities, industrial, commercial and institutional customers. As a part of this, it also has developed a world-wide consulting and engineering practice based on its expertise from its operations.

Helsinki, Finland

Helsinki[65], Finland's capital city has a population of 578,000, a greenhouse gas performance of 6 mt per capita and an integrated long-term energy plan in place to reduce this even further. While Helsinki is among the highest of Scandinavian cities, its emissions level is impressive when put in the context of a climate with a substantial heating demand and most electricity still produced by coal.

Cogeneration is the key to efficient fossil and non-fossil fuel conversion. Over 93% of all Helsinki's buildings are served with district heating, with the vast majority of the heat coming from heat recovered from the generation of electricity, the vast majority of which come from coal and natural gas. Electrical generation of 1,300 Megawatts produced in four major plants is associated with cogeneration. The conversion efficiency of the fuel can be as high as 90% in the winter due to the strong demand for heating. This drops dramatically in the summer, exacerbated by increases in electrical demand for conventional cooling. As a result the City is strategically extending the district cooling network to increase the potential for cogeneration in summer through the use of heat to generate cooling.

Since the 1950's Helsinki has invested in a widespread district heating network about 1,000 kilometers long and delivering 7,000 GWh of heat every year to over 90% of all heat consumers in the city. In addition to the 4 main CHP plants, the city has 10 gas or oil fired boiler plants used to serve the heating shoulder and peak requirements. In total these have a capacity of about 2,000 MW thermal equivalents. By centralizing heat supply into a few industrial grade boilers with professional continuous maintenance and operation, the conversion efficiencies will be in the 80 to 90% range. On aggregate this will be much more efficient than the thousands of individual units they replace. This conversion benefit is not restricted to fossil fuel. The same arguments of scale will apply equally to bio-mass heat only boilers for example.

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[65] Helsinki home page in English
http://www.hel.fi/wps/portal/Helsinki_en/?WCM_GLOBAL_CONTEXT=/Helsinki/en/Etusivu

All cities generate substantial amounts of waste. Helsinki has a rigorous reduction and recycling approach to waste management. The remaining waste from the Helsinki region has a relatively high calorific value and for all practical purposes has similar greenhouse gas emissions potential as biomass. At the end of 2008 the city has awarded a contract[66] to build a cogeneration (electricity and district heat) waste-to-energy facility with the capacity to handle up to 320,000 tons per year.

Helsinki is just one of many examples of efficient conversion in a city setting and this is also a key to competitive prices. Since 2004, heat prices in the city have increased by 40% over a time when natural gas globally has more than doubled in price. Over the same time, electricity prices have stayed significantly less than the surrounding country norm. At €0.068 per kWh (US 8.9 cents) they compare favorably with many parts of North America and most of the rest of Europe.

The importance of a holistic approach to community energy planning is apparent in Helsinki. The ability to take the full benefit of efficient cogeneration and efficient heat-only sources is closely connected with the district heating and cooling infrastructure of the city. It also allows it to capture and use the waste heat from industrial and commercial process that produce large amounts of waste heat. These include commercial refrigeration, air conditioning, and energy intensive industries such as glass, metals, and cement. The overall result is to increase primarily fuel conversion efficiency albeit in two or three steps of a thermal cascade. A good example of this in scale is in the city of Aalborg[67], Denmark.

Aalborg, Denmark

Aalborg[68] is a city of 162,000 located at the northern tip of Denmark, with a diversified economy. Between 1990 and 2002, the population grew by 4.5%, outpaced by an 8% increase in local employment while non-transport related greenhouse gas emissions fell by about 22%. This puts Denmark on track to meet its national Kyoto target of about 33% on equivalent basis.[69] Today, Aalborg has non-transport related per capita greenhouse gas emissions of 4.4 mt compared to about 7.6 mt nationally.

Aalborg is a good example of an integrated approach to utility planning and execution. Aalborg's district heating and cooling infrastructure captures and uses the waste heat from industrial and commercial process for residential and commercial consumers. Aalborg Portland, a local cement works, sources 1,500 terrajoules of heat for delivery via the district heating system. This represents about 25% of all heat demand of the city. Cement plants are collectively responsible for about 5% of energy related greenhouse gas emissions worldwide, so developing a strategy to use their waste heat is significant.

Aalborg is also a good example of a flexible approach to energy supply. Denmark has a clear national strategy to diversify electricity sources with major focus on renewable and

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[66] See http://www.ytv.fi/ENG/future/waste_power/brief/frontpage.htm and associated links for details of the new waste-to-energy plant in Helsinki.

[67] See http://www.aalborgkommune.dk/NR/rdonlyres/7F8DA105-0CB7-4BFB-B764-CF5405045171/4971/rapportuk.pdf for an English summary of the Aalborg city energy structure.

[68] See http://www.aalborg.dk/Engelsk/default.aspx to go to the English home page of Aalborg

[69] See http://www.eea.europa.eu/publications/eea_report_2007_5/Denmark.pdf for fairly recent update on Denmark's national performance relative to its overall 21% reduction goal.

cogeneration. A blend of incentives and disincentives have resulted in the highest penetration of wind electricity in the world with a high share of district heating supporting large and small scale cogeneration. Aalborg has built on both of these national priorities and exceeds national performance on most measures.

The District Heating Utility Company purchases heat from a variety of sources. Some of these are low cost and some are low carbon. This avoids dependence on any one source, and allows cost and environmental priorities to be managed over decades. The city also sources heat from a few smaller gas-fired CHP units and peaking boilers, combined with heat recovered from the 2 main sewage treatment plants. The effect of this flexible heat sourcing strategy is clearly evident in the overall greenhouse gas performance of the heating supply.

North American Initiatives

Mannheim and Copenhagen were chosen as examples of the results when efficiency, flexible distribution and efficient fuel use are combined in an entire city. There are no real parallels in North America. However, there are indicative examples that are relevant.

California Title 24 - Building Efficiency

California has had a systematic approach to reviewing, measuring and upgrading building efficiencies dating back to 1978[70] 1978[71], when the state mandated the California Energy Commission with managing a process to continuously increase the efficiency of new construction. As a result of California's unique North American approach, the average efficiency of new construction in California exceeds that of the rest of the US by as much as 30%. Referred to as "Title 24", this legally binding building code is systematically updated every three to four years. Currently the 2005 edition[72] is in effect, with the next phase of it coming into force on the 1st August 2009[73]. Overall, the building stock is (on average) between 30 to 40% more efficient than the rest of the US and this will continue to increase as the 2005 version impacts the overall building stock. The details of the next update are already published, having the effect that the market will tend to "build forward" both by cities challenging builders to anticipate the new codes during the permitting process, and through customers anticipating the next round of updates in their purchasing decisions.

Markham District Energy

Markham District Energy Inc. (MDEI) is an energy company created in 2000 to offer an environmentally sustainable energy solution to developers. Municipally owned, it plans to serve about 988 acres (400 hectares) of the downtown core containing 192 acres (78 hectares) of open space and 75 acres (30 hectares) of parkland. The ultimate goal is to connect 25,000 residents, 17,000 employees and an estimated 15 million square feet (1.4 million square meters) of new industrial, commercial, and residential space. The facility will utilize a CHP plant

[70] See California Energy Commission Title 24 http://www.energy.ca.gov/title24/
[71] The California Energy Commission archive for Title 24 is available at http://www.energy.ca.gov/title24/standards_archive/
[72] See http://www.energy.ca.gov/title24/2005standards/index.html for current CEC Title 24
[73] See http://www.energy.ca.gov/title24/2008standards/index.html for 2009 Title 24

and high efficiency boilers, reducing natural gas usage by 25% and resulting in lower GHG emissions and will operate in parallel with the local electric utility.

Like all district energy systems, it has the flexibility to be expanded as the need or opportunity arises and to incorporate alternative fuels. Ultimately the goal is to have over 90% of the developed square footage of Markham Centre connected to the community energy system. Phase One was installed in 2002. Phase Two plans to expand this community owned heating and cooling[74] cogeneration distribution system northwards and eastwards, with infill of the existing system and installation of chilled water storage technology and efficiency upgrades. These activities are necessary to grow the customer base to match the heating and cooling capacity currently available from MDEI's existing plant and to attract more customers.

Another innovative project by Markham District Energy Inc. (Ontario) is the energy from waste facility study[75] which investigates the economic and technical feasibility using fuel extracted from organic waste for its district heating system (blends biogas with natural gas to fuel a DE plant). Three benefits are anticipated: creates a local waste solution; provides a means of hedging natural gas volatility and high costs; and has lower GHG emissions to improve air quality. It is also anticipated to work in conjunction with other waste management plans and anaerobic digester projects.

The current MDEI production facility has a combined heat and power (CHP) plant (3.5 megawatt (MW) electrical and 3.2 MW thermal capacity) plus additional high efficiency boilers (10 MW capacity) and absorption chillers (1.5 MW capacity). It is estimated that once the current capacity of the CHP plant is reached at 10 MW peak heating load, the district energy system will require approximately 25% as much natural gas as the business-as-usual alternative of individual furnaces. This equates to natural gas savings of 1.7 million cubic meters and GHG reductions of approximately 3,200 tons of CO_2 equivalent per year.[76]

BC Hydro

BC Hydro is the third largest utility in Canada, generating and distributing between 43,000 and 54,000 gigawatt hours (GWh) of electricity annually, in a service area covering 94% of British Columbia's population. Through the efficient and reliable supply of electricity, BC Hydro supports the development of British Columbia and has constructed a world-class integrated hydroelectric system. Due to this efficient, reliable system, British Columbians enjoy some of the lowest electricity rates in North America. BC Hydro operates 30 hydroelectric facilities (80% hydroelectricity generated on the Columbia and Peace Rivers) and three natural gas-fueled thermal power plants. It balances British Columbians' energy needs with the concerns of the environment, providing energy solutions to its customers in an environmentally and socially responsible way.

BC Hydro is consistently one of the lowest greenhouse gas emitters in the North American electricity market. It is committed to reducing its environmental footprint through conservation, demand-side management (DSM) programs, operational efficiencies and clean or renewable energy supply initiatives. These include sources of energy that are constantly renewed by

[74] See www.markhamdistrictenergy.com

[75] FCM GMF: http://www.sustainablecommunities.fcm.ca/Search/Search/Search.aspx?lang=e

[76] FCM GMF: http://www.sustainablecommunities.fcm.ca/Search/Search/Search.aspx?lang=e

natural processes, such as large and small hydroelectric, solar, wind, tidal, geothermal, wood residue and energy from organic municipal waste.

BC Hydro's sustainable initiatives include the DSM Power Smart program with a triple bottom line approach to curtailing demand for electricity; Resource Smart utilizing large hydro and thermal generating resources with little to no incremental impact to the environment; and purchasing B.C. Clean Electricity from independent power producers encourages sustainable economic development while lowering GHG emissions. Offsets allow BC Hydro to use flexible market mechanisms that deliver the same environmental and societal benefit as an on-site reduction at less cost, leading to higher performance across all three bottom lines. Integrated energy planning will incorporate GHG emissions considerations into BC Hydro's long-term energy supply decision-making process.

BC Hydro is actively involved in community energy planning (CEP) assisting municipalities to reduce their consumption and improve their energy efficiency. District energy, combined with combined heat and power generation (CHP), is a primary mechanism by which to achieve the important GHG reductions needed to bring BC's emissions down to those of leading world regions. As well, BC Hydro is working with the BC government and industry on energy efficiency standards for buildings under the Energy Efficiency Act and towards a municipal energy performance labeling program for homes and buildings.

Davis, California

The City of Davis, California is a good example of how a smaller town, without historical traditions of mass-transit that can be resurrected and remodeled for the 21st century, tackles its transportation problems. In Davis, the emphasis has been on restraining sprawl through tight zoning and development guidelines. In addition through structured developments of cycle paths both alongside normal roads, within the footprint of normal roads, and through parks and greenbelts, the city is justly claiming to be a model of productively creating a culture where the car and the cycle cohabit well together[77].

Symbol of Davis Outside City Hall

[77] See http://cityofdavis.org/pgs/Sustainability/pdfs/CAT/CAT-Community-Forum-Transportation-Comments-Summary.pdf for the recent briefing notes on transportation by the Davis Climate Committee

Davis may well see its structured approach to creating a bike friendly environment rewarded by being the permanent host to the US Bicycle Hall of Fame; appropriate for a city with the penny-farthing bike as its symbol.

Austin, Texas

The city of Austin, Texas *Climate Protection Plan*, adopted by City Council resolution in 2007, emerged from earlier efforts dating back to the 1980s and 1990s that aim to make the City's operations, facilities, vehicle fleets, and utilities carbon–neutral by 2020. Earlier measures involved the green building rating system and the Clean Energy Incubator - a consortium of business, academic and state government leaders devoted to helping clean-energy companies succeed. Their innovative 32-mile light rail transit system is expected to reduce the number of drive-alone commuters and metro congestion.

Austin Energy[78] installed its first electric-driven district cooling system, serving part of the downtown, and it will soon be expanded to a second phase. This system serves commercial and multi-family residential customers. They also operate a district energy system in a light industrial park supplying electricity, steam, heating, cooling and compressed air. Austin Energy is a regulated electric utility owned by the City of Austin, also supplying value-added services including district energy via its deregulated business unit.

Austin's Climate Protection Plan[79] is structured on five components that include a municipal plan, utility plan, homes and buildings plan, community plan and "Go Neutral" plan. The municipal plan aims to: make all City of Austin facilities, vehicles, and operations carbon-neutral by 2020; power all city facilities with renewable energy by 2012; make the entire city vehicle fleet carbon-neutral by 2020 through the use of electric power, non-petroleum fuels, and mitigation measures; establish a city employee Climate Action Team to manage both an inventory of greenhouse gas emissions from all municipal operations and a comprehensive emission reduction plan; and create a city employee climate protection education program, that includes information and incentives to help employees reduce their carbon footprint along with training on how to educate other community members on ways to reduce their carbon footprint.

The utility plan aims to expand conservation, energy efficiency, and renewable energy programs to reduce Austin Energy's carbon footprint; cap carbon dioxide emissions from existing power plants; make any new electricity generation carbon-neutral; and meet 30% of all energy needs with renewable resources, including 100 megawatts of solar power, by 2020.

The homes and buildings plan will update building codes to make all new single-family homes capable of meeting 100% of their energy needs with on-site generation of renewable energy by 2015; enhance building codes to increase energy efficiency in all other new buildings by 75% by 2015; require disclosure of historic energy use and cost-effective energy efficiency

[78] See http://www.austinenergy.com/Commercial/Other%20Services/On-Site%20Energy%20Systems/districtcooling.htm
[79] The City of Austin has launched the Austin Climate Protection Plan (ACPP) www.coolaustin.org. A reporting of progress against the plan is available at http://www.coolaustin.org/acpp_progress.htm.

improvements upon the sale of all buildings; and enhance technical assistance, standards, and incentives for Austin Energy's Green Building program.

The community plan will engage Austin citizens, community groups, and businesses to reduce greenhouse gas emissions throughout the community.

The "Go Neutral" plan will create an Austin-specific online carbon calculator for citizens, businesses, and organizations to calculate their greenhouse gas emissions and provide customized assessments for more complex organizations and entities; develop options for citizens, businesses, and organizations to reduce their carbon footprint through local greenhouse gas emission reduction projects; establish a program for recognition of households, businesses, and organizations that achieve carbon neutrality; promote carbon neutrality among visitors by providing mechanisms and incentives for reducing the carbon footprint of airport travelers, conventions, trade shows, and festivals.

The inter-departmental Climate Action Team is developing a baseline carbon emissions inventory and creating recommendations for reducing the City of Austin's carbon footprint. Once complete, the team will then set and implement reduction targets for all city departments. The city will establish a dialogue with the Austin community to identify opportunities for GHG emission reductions, and to ensure that every individual has a chance to participate in climate protection efforts.

Lonsdale Energy System

In 2004, the City of North Vancouver, British Columbia, Canada retained the services of the Lonsdale Energy Corporation (LEC)[80] and their operating partners to provide a district energy service as part of its ongoing commitment to sustainability. As a municipally managed corporation, supported by city council energy zoning, LEC operates a modern system that delivers high efficiency heating services to its customers using a pressurized hot-water network supplied by efficient natural gas boilers. Buildings are connected to the LEC system with individual heat-exchangers. This simplifies the plant needed in each building, freeing up space and reducing maintenance and other costs.

Starting with a network serving two buildings, the system has grown and by 2010, LEC anticipates serving 20 Lower Lonsdale buildings totaling 300,000 square meters of building area. LEC is planning to incorporate solar energy into their energy system by building 120 solar hot water panels on the roof of the new library and is investigating the use of a geo-exchange heating system. A geo-exchange or geothermal heat pump system takes advantage of the constant temperature of the earth's surface (ranging between 10-degrees and 16-degrees Celsius) through a heat-transfer process. As a result of incorporating clean and renewable energy generation, LEC has been able to expand service to Central Lonsdale, where the city's new Library/Civic Centre is being constructed, and Upper Lonsdale, where exploratory drilling is underway on the Harry Jerome/Lonsdale School sites. The city has a clear vision to systematically expand the district heating utility. The initial growth has been encouraging, mostly focused on selected renovations and newly constructed buildings. Various approaches are

[80] Lonsdale Energy Website: http://www.cnv.org/server.aspx?c=2&i=98

being discussed to accelerate the scale-up including commercial conditions and changes in energy services zoning.

Supplemental Reading on Sustainable Municipal Experiences

Many supplemental readings exist for the reader interested in further background as to the different ways in which North American, European and other international cities are responding to the challenge of becoming greener, cleaner and more energy efficient. Cited below are some sources that provide many ideas and approaches. This is only a limited list and many more examples can be found through a web search.

United Cities and Local Governments – A global organization that shares broad items of interest to cities around the world. http://www.cities-localgovernments.org/uclg/index.asp

Energie Cites - A European organization, with membership beyond European borders, focused on promoting sustainable energy approaches. http://www.energie-cites.org/
Sustainable Communities - This US based organization has a broad range of material and links to a variety of city initiatives in the US and elsewhere. http://www.sustainable.org/

Mayors' Asia-Pacific Environmental Summit - An annual forum, promoting sustainable development, where Mayors and senior local government officials (representing over 100 cities from 29 countries) share information, best practice and build partnerships. http://www.environmentalsummit.com/

ICLEI: Local Governments for Sustainability - Currently having a membership of over 1,000 local, regional and national, governments ICLEI promotes sustainability through a number of programs and initiatives that it oversees. http://www.iclei.org/

Smart Growth - Dedicated to walkable, compact vibrant communities. http://www.smartgrowth.org

Western Climate Initiative (WCI) - Created in 2007, WCI is a collaboration of seven US and Canadian leaders that identifies, evaluates and implements collective and cooperative ways to reduce GHG emissions in the region (focused on market-based cap and trade system). http://www.westernclimateinitiative.org/

Federation of Canadian Municipalities (FCM) - FCM has represented municipal governments of all sizes in Canada since 1901 on policy and program matters that fall within federal jurisdiction. http://www.fcm.ca

An underlying theme of all these initiatives is the vital contribution that sustainable, clean and economic energy, transportation and water services add to the overall attractiveness and competitiveness of urban environments. The reverse is clearly true; expensive, unreliable and polluting energy and water systems will ultimately become a deterrent to investors, inhabitants and tourists.

Appendix D: Governmental Leadership

Overview

Successful implementation of the County Energy Strategy depends on the motivation and support of the entire community. As community leaders, local governments have a major responsibility in taking the lead in standing behind the goals and principals of the Strategy. At the start of the planning process, the CES Team made initial steps identify and summarize the resources and programs already underway within the individual towns and the County government. The attached results are impressive.

Loudoun County Public School District

The Loudoun County Public School District (LCPS) has assembled a wide-ranging Energy Education Team. This team will reduce the use of energy throughout the school system, improve the educational environment, and ensure efficient and effective stewardship of public resources. The team's goals are to reduce energy use and cost without jeopardizing quality by:

- Developing energy savings habits within all levels of facility users.
- Implementing energy saving programs and practices.
- Evaluating and utilizing the most effective energy providers and rates.
- Reviewing and authenticating energy usage and billing.
- Facilitating timely processing of all utility bills.
- Researching and recommending energy efficient methods and materials.
- Generating an attitude and culture of energy savings.
- Representing LCPS interests in committees and organizations.
- Providing data and counsel regarding energy usage and cost.
- Observing and reporting areas for energy use reduction.
- Coordinating energy savings efforts with all departments within LCPS.
- Incorporating energy accounting software to maintain clear and accurate records.
- Developing and maintaining professional and industry contacts.
- Seeking program improvement through staff development.

The LCPS Energy Education Team partnered with Energy Education Incorporated (EEI) to create and implement a transformational energy management program.

The LCPS Administration Building is LEED-certified. The U.S. EPA presented LCPS with the coveted ENERGY STAR award for 22 of its sites in July, 2008. This Award recognizes the LCPS Support Services Department and its Energy Education Program for "achieving superior energy and environmental performance".

Loudoun County

The Loudoun County Government has led numerous initiatives related to sustainability, technological innovation, building practices, and energy conservation initiatives. The Loudoun County Board of Supervisors has approved the implementation of extended energy-conservation measures at the six largest energy-using County-operated or -owned facilities. These are projected to reduce energy consumption of County operations 15% by 2012. Other measures include installing high-efficiency lighting; reprogramming controls to limit electric demand and more efficiently deliver outside air to heating and cooling systems; and improve weatherization and water conservation. In January 2009, the Loudoun County Board of Supervisors created a new standing Committee on Energy & Environment, which replaced the ad-hoc Committee on Energy Efficiency formed a year earlier. The County also is part of the ENERGY STAR partnership and will:

- Measure and track the energy performance of County facilities using the wide array of ENERY STAR tools.
- Develop and implement a plan consistent with the ENERGY STAR Energy Management Guidelines to achieve energy savings.
- Help disseminate information about the importance of energy efficiency to the Loudoun County government workforce and citizens.
- Support the nationwide ENERGY STAR Challenge to improve the energy efficiency of America's commercial and industrial buildings by at least 10%.
- Receive recognition on the ENERGY STAR web site as a partner and as a participant of the ENERGY STAR Challenge.
- Share its progress to meeting the challenge, as an ENERGY STAR Partner.

The Loudoun County Board of Supervisors endorsed October 2008, as Energy Efficiency and Conservation Month. As part of this effort, the County joined in a nation-wide effort to promote public understanding of our energy needs and reduce energy consumption. Programs and activities have focused both on what Loudoun County employees can do in their homes and office and what residents and businesses can do to save energy and reduce the carbon footprint of the County. The County also has:

- Adopted LEED Silver as the Green Building standard for new county facilities.
- Adopted a 15% energy reduction goal for Loudoun County government by 2012, with clear progress already underway.
- Tied for first place in the 2008 Virginia Municipal League's "Green Government" Challenge.
- Created the *Energy Conservation Cabinet* – a body of staff from each County department that will engage all employees in best practices to reduce energy. It has yielded $124,000 in annual savings to date and growing.
- Pledged to reduce the carbon emissions of County operations by 3% in 2008 as part of the Metropolitan Washington Council of Governments' "Cool Capital Challenge." In 2008, this goal was exceeded by 3%.
- Conducted comprehensive energy audits of six major County facilities and identified facility improvements to reduce energy costs by at least 9%.
- Plans to start energy audits of the County's remaining 44 buildings to identify retrofits and improvements to save additional energy costs.
- Implemented a tele-work program that has resulted in 1.5 million less miles driven each year by Loudoun County employees.
- Reduced vehicle miles traveled by more than 26 million riders in 2008 using public transportation in lieu of single occupant vehicles.
- Saved 20.2 tons of NOx (Nitrogen oxides) and 6.25 tons of VOC (Volatile Organic

Compounds) emissions by passengers using the commuter bus program.

- Implemented recycling programs in County government offices and schools resulting in the equivalent of 2.2 million kilowatt hours in energy savings per year.
- Increased the use of recycled content paper products including 35% post-consumer recycled copy paper, and 100% recycled tissue paper and paper towels.
- Purchased Energy Accounting Software to manage data.

Town of Leesburg

In 2008, the Leesburg Town Council adopted Resolution 2008-158 for reducing Town government energy use 10% by 2012. The actions to meet this goal are detailed in the Town's Strategic Energy Conservation Plan. The Leesburg Energy Efficiency Program Group has led the completion of energy audits and tracks energy use with the U.S. EPA's Portfolio Manager Software relative to a 2007 baseline. The Town also has two initiatives aimed at the wider population: the Energy Education Plan and the Change a Light Campaign.

Town of Purcellville

The Town of Purcellville adopted a new comprehensive resource plan in 2006. Purcellville aims to be a regional standard for effective, integrated utility planning and growth management. The resource plan examines water and sewer facilities to appropriately address desired future land use patterns. The resource plan encourages utility systems that are cost-effective, efficient, and include state-of the art technology that promotes environmental protection, conservation and green development. Purcellville aims to be recognized for effective inter-modal transportation systems and street, pedestrian and trail connections that enhance community connectivity, preserve special community assets, promote attractive environments and improve transportation safety. Purcellville's codes also recognize the need to protect and conserve forest and agricultural lands through specific districts, particularly because of the production of local food. Purcellville recognizes these initiatives are essential for the long-term competitiveness of the community as well as for the impacts on the local and global environment.

Town of Lovettsville

The Town of Lovettsville is in the process of updating their Comprehensive Plan which will reflect their long range vision to preserve and nurture its rural character while developing realistic growth goals. The Town also has a streetscape plan and a pedestrian-bike path along Route 287. Completion of the wastewater treatment facility expansion is expected in the fall of 2009.

Town of Middleburg

The Town of Middleburg adopted a 2008 Vision for the Future, which stressed that *"Middleburg is a leader among small towns in the green conservation movement. Through the efforts of area residents, Town citizens and leaders we have achieved recognition for creative and cost saving approaches to educating our citizens about environmental stewardship and the application of green technologies, while maintaining our historic character. Middleburg's economy, agricultural infrastructure, and food supply are locally sustained by an active commitment to 'buy local, buy fresh'".* This broader sustainability Vision will have significant impacts on both the energy and greenhouse gas impacts of the community.

Town of Round Hill

The Town of Round Hill adopted their Comprehensive Plan which values conservation and complements regionalized efforts that support the environment. The plan proclaims *"Round Hill as a community should be committed to educating its individual and business citizens on the necessity of conserving resources and improving the condition of the environment"* and aims to *"support environmental protection programs and codes on a regional basis in recognition of the regional scale of environmental management concerns."*

Town of Hamilton

The Town of Hamilton values the environment and sustainable practices in the adoption of their Comprehensive Plan. The town highlights "*horizontal threads*" that tie together all of their future plans. One of these overarching concepts is to "*uphold a high standard of environmental stewardship, promoting clean air and water and promoting effective tree, waterway and wildlife preservation standards*." Moving forward, energy will be clearly one of these unifying "horizontal threads."

Appendix E: CES Projection Assumptions

1.0 General Basis for Future Projections

To create a view of the possible future energy use for Loudoun County, many sources of information were utilized and several assumptions were made. The built environment in 2040 will consist of new structures built after 2009 and most of the current residences and buildings in place today. Transportation needs will grow along with jobs and population growth. To show a set of possible future alternatives, three scenarios were created. Appendix E summarizes the basis for the Base Case, Future Case 1 and Future Case 2 results presented in the Report.

1.1: Built Environment Base Case – New Construction

The future build-out for Loudoun County is based on the County Growth Summary[81] with the future number of detached, attached and multifamily housing units and jobs projected out through the year 2040. Non-residential square footage for buildings is based on future job growth estimates and the calculated square footage per job in place today in the County.

Future building energy consumption was modeled using eQuest results for the building types of detached, attached, multifamily, retail and office, and the Growth summary projections on units and jobs out through 2040.

Near Term Future for Energy Construction Codes

New construction will be regulated by the current and subsequent versions of the Virginia Energy Code. The Virginia Uniform Statewide Building Code (USBC) is the statewide minimum requirement that local jurisdictions cannot amend. The code is applicable to all new buildings in the Commonwealth. Residential energy requirements are based on the 2006 IECC. Non-residential buildings are is based on ASHRAE 90.1-2004 standards.

The Virginia Department of Housing & Community Development has begun the process of examining the current statewide energy code, with plans to adopt 2009 IECC and ASHRAE 90.1-2007 with an expected implementation in late 2010. The applicability is based on that date of permits approval, not the date of construction start, so wide-spread implementation will occur within a few years of the eventual adoption date.

When implemented, both energy codes are expected to have improvements in energy performance. The 2009 IECC is estimated to have a 10-12% improvement for residential in the Loudoun County area[82]. The ASHRAE 90.1-2007 is expected to have in the neighborhood of a 5% improvement for commercial buildings[83]. For modeling the Base Case, it is assumed the new Virginia energy code will improve code-to-code performance by 10% in 2011.

[81] http://biz.loudoun.gov/Home/FactsStatsandMaps/Publications/GrowthSummary/tabid/191/Default.aspx
[82] ICF Report, Jan 2009; http://www.thirtypercentsolution.org/solution/EECC-Savings_Analysis-Jan-2009.pdf
[83] Owens Corning Science and Technology, LLC

Longer Term Future for Energy Codes

The ASHRAE Board of Directors has provided direction for the future development of the commercial ASHRAE 90.1 Standard. The guidance suggests a target of about a 50% reduction in the Standard over the next 15 years. Separately in Washington, DC, legislation is working its way through Congress and, as drafted, would set 30% and 50% reduction targets for residential and commercial energy codes in a shorter timeframe. While predicting the future outcomes of Congress and ASHRAE with any accuracy is problematic, it would be reasonable to say that energy codes will improve over the next several decades, and will likely begin to approach a 30 to 50% code-to-code reduction from the current energy codes in place today. Current European Codes under the 2002/91/EC Energy Performance of Buildings Directive[84] would approach this higher level today in most member states.

Energy Codes and Total Building Energy Consumption

Energy codes regulate the building envelope and some building equipment, but not all energy use. It does not include electrical plug loads, which would include the use of appliances, computers, entertainment equipment and other devices. For example, an analysis of the estimated plug loads for different office buildings showed variation between 6 and 22% of total energy consumption[85], due to climate, building size, and the amount of window area. There would be further variance for different types of buildings. For modeling code impact for the CES, plug loads are assumed to be 14% of total energy consumption, meaning the code impacts the remaining 86% of energy use. The result of every 10% energy code improvement will have a smaller net percentage reduction on the total energy consumption. This magnitude of energy code improvement is expected to reduce site energy use by 8 to 9%.

Energy Code Requirements and Compliance

Most new buildings would be expected to meet the minimum energy code. However, compliance evaluations show a sizeable portion does not meet code. In one commercial energy study, compliance with the lighting code was estimated at only 80% compliant on new construction.[86]. A California study showed approximately 12% of residential sites is non-compliant[87]. Similar work in Arkansas[88] and Nevada[89] showed a percentage of units examined at levels of performance below code. In Massachusetts, a 1998 study[90] revealed that only 46% of the new homes sampled actually met the code. While codes are a major influencer of building energy consumption, there is a variance due to this systemic non-compliance. Actual energy consumptions will be higher than projections based solely on the energy code itself.

As a result of these preceding considerations, the CES Base Case for New Construction assumes that new codes are implemented in 2011 with a 5% overall improvement to the current

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[84] http://europa.eu/legislation_summaries/energy/energy_efficiency/l27042_en.htm
[85] Owens Corning Science and Technology, LLC
[86] 2007 Commercial Energy Code Compliance Study: http://www.energycodes.gov/implement/pdfs/2007CommercialEnergyCodeComplianceStudy.pdf
[87] Residential New Construction Study; http://www.energycodes.gov/implement/pdfs/ca_compliance_2002.pdf
[88] http://www.energycodes.gov/implement/pdfs/ak_compliance_1999.pdf
[89] http://www.energycodes.gov/implement/pdfs/nv_compliance_2003.pdf
[90] http://www.energycodes.gov/implement/pdfs/ma_compliance_2001.pdf

code. Future improvements are assumed at 1.0% per year from 2012 to 2040. The non-compliance variance was conservatively assumed to be a 5% higher site energy consumption. The 14% electrical plug loads are held constant; assuming the relative growth in applications will be compensated for by an equivalent evolution of improving efficiency in each individual application.

1.2: Built Environment Base Case – Existing Homes and Buildings

The existing building stock will not remain static over the next 30 years. Energy improvements, such as equipment and appliance replacement, will occur. Building envelope changes will also happen to many structures, like window and roof replacement, as well as air sealing and insulation upgrades. Based on extensive knowledge of the US construction market, the Owens Corning members of the CES Team recommended Base Case assumptions that reflect the historical evolution of renovations.

Based on these considerations, the CES Base Case for Existing Homes and Buildings assumes 100% of the existing building stock will undergo deep renovation by 2050 starting from 2010. The rate of renovation will be linear over this period. From 2010 those buildings assumed to have deep renovation will be 15% more efficient than the existing average. In subsequent years the renovation efficiency is assumed to be constant at 15% from 2009 through 2050.

1.3: Transportation Base Case

In developing the Base Case for Transportation, the CES Team assumed a continuation of the today's "business as usual" (BAU) approach that overwhelmingly favors automobile transportation. In 2008, 96% of Loudoun County residents used passenger automobiles for their daily work commute. Two percent of commuting journeys used the bus, one percent walked and a few bicycled. Non-commuting journeys within the county were a similar pattern.

This pattern already results in serious congestion during peak travel times on the County corridor routes connecting hamlets, towns and larger communities. This results in reduced fuel efficiencies and levels of greenhouse gas emissions somewhat higher than the US average. With the expected growth in population, the risk of increasing congestion, pollution and inefficiencies increases.

Both public and private initiatives to alleviate this are being introduced. Loudoun County is developing a "green fleet" policy encouraging purchase of fuel efficient vehicles. About 11 percent of the county's sedan/small SUV fleet is hybrid vehicles, with fuel and savings over conventional gasoline cars. Many organizations are promoting telecommuting, carpools, vanpools, biking and an incentive based ride network.[91].

Other initiatives are underway. The current Loudoun County Transit Plan[92] calls for a change in share between different transportation modes. Many residents are also looking for a more efficient future with more bicycle and pedestrian-friendly mobility options available. In addition to the Loudoun County Transit Plan, these initiatives form part of planning documents such as the,

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[91] http://www.loudoun.gov/Default.aspx?tabid=2403
[92] http://www.loudouncountytransitplan.com/

the Northern Virginia Transportation Authority's Trans Action 2030 Plan[93], the Virginia Department of Transportation's Northern Virginia Regional Bikeway and Trail Network Study[94] and the Loudoun County Bicycle and Pedestrian Mobility Master Plan[95].

Additionally, the Clean Air Act Amendments 1990[96] introduced measurement criteria and standards impacting Loudoun County, and incented transportation changes. Loudoun County, located within the Washington DC-MD-VA region, is required through the State Implementation Plan (SIP) to improve its air quality as the region was declared a "nonattainment zone".

For the purpose of clarity within the County Energy Strategy, the CES Team made the arbitrary decision that these and other initiatives would not be included in the Transportation Base Case. This avoids making equally arbitrary decisions as to the degree to which each of these initiatives would be adopted. The CES Transportation Base Case assumes the transportation use of energy will increase from its 2007 level linearly with the growth in population.

2.1: Built Environment - Energy Efficiency: Future Case 1

Energy efficiency in homes and buildings is a crucial element of any future energy strategy. As a reminder, they currently consume over 70% of the county's entire energy usage and create more than 60% of the greenhouse gas emissions. The CES recommendations focus on strategies that encourage construction at efficiency levels at least 30% higher than current code for new buildings, and that encourage energy retrofit of existing structures at higher levels, and more rapidly than in the past. To minimize non-compliance, the CES recommendations are aligning with current EU practice and encourage providing current building energy performance labels for all buildings at their point of sale, resale or lease.

Many programs exist that encourage better-than-code energy performance. For residential, the Department of Energy *Builder's Challenge*[97] and the National Association of Homebuilders *National Green Building Program*[98] both can achieve 30% better than the current code. For commercial buildings, ASHRAE produced six Advanced Energy Design Guides[99], which set targets at least 30% better than ASHRAE 90.1, while the USGBC's LEED NC[100] has categories at and above 30% better than code.

The CES Future Case 1 for New Construction assumes 30% better than code is being achieved from 2011 for modeling purposes, resulting in a net 25% overall improvement over Base Case starting in 2011, again with a 1.0% annual improvement at least out to 2040.

The CES also addresses the energy use in existing buildings, by again recommending strategies that encourage higher level of efficiency either in the form of focused energy retrofits

93 http://www.thenovaauthority.org/transoverview.html,
94 http://www.fhiplan.com/novabike/
95 http://www.loudoun.gov/Default.aspx?tabid=571
96 http://www.epa.gov/air/caa/
97 http://www1.eere.energy.gov/buildings/challenge/builders.html
98 http://www.nahbgreen.org/
99 http://www.ashrae.org/technology/page/938
100 http://www.usgbc.org/DisplayPage.aspx?CMSPageID=220

or during major remodeling. Existing buildings can benefit from existing programs like EnergyStar, or local area utility programs focused on energy improvements.

The CES Future Case 1 for Existing Homes and Buildings is modeled on the assumption that 100% of the existing building stock also undergoes deep renovation by 2050 starting from 2010. The rate of renovation will be linear over this period. From 2010 renovation will be 25% more efficient than the existing County average for property of all ages. In subsequent years the renovation efficiency will increase 1.0% per year through at least 2040 from this staring level.

For modeling Future Case 1, all buildings are assumed to have a current Energy Performance Label. New buildings are assumed to have a shift in performance of 5% resulting from improved compliance through information transparency.

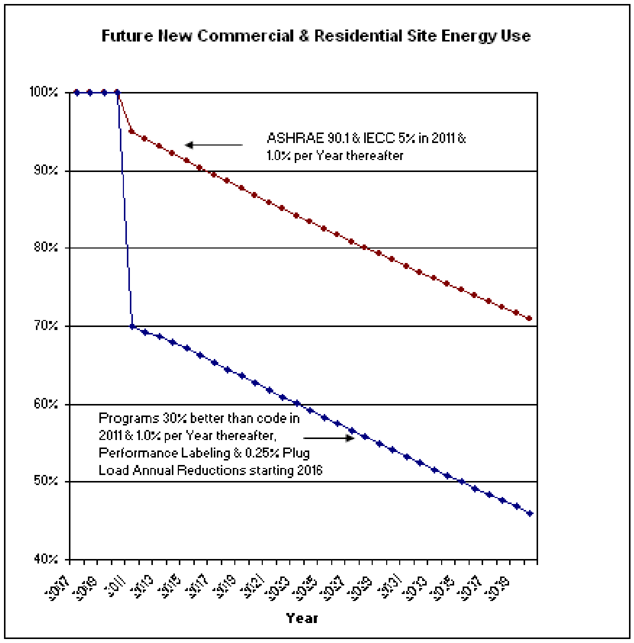
In summary, the preferred actions in Future Case 1 include:

- Achieve a target 30% building performance better than the State Energy Code beginning in 2011 for all new construction. For both residential and commercial, implement an average 1.0% per year efficiency improvement to the 30% target starting in 2012 and going through 2040 for all new construction.
- Beginning in 2010, major residential and commercial renovations will be 25% more efficient than the current County average, and then improve 1% year on year through 2040.
- All homes and buildings will have a current Energy Performance Label whenever sold or rented, using a low cost certification process.
- Any residential or commercial building larger than 10,000 ft2 regularly used by the public or employees will be expected to display a current Energy Performance Label

Finally, the CES Future Case 1 assumes that by 2016, all new appliances have a deep stand-by function that will reduce standby power by upwards of 90%. To model this, it is assumed the aggregate plug loads are reduced from 14% of all energy to 7% by 2040. This evolution takes into account replacement cycles of existing equipment.

The cumulative effect of these recommendations for new construction is summaries in Figure E.1.

Figure E.1: Base Case and Future Case 1 for New Construction Site Energy Use



2.2: Transportation Energy Efficiency: Future Case 1

The Future Case used by the CES addresses six main areas that will influence the total transportation energy and resulting emissions. Some of these build on existing transportation initiatives seeking to both increase convenience and access and to lower energy used for transportation, and summarized in the Base Case.

The CES Transportation Energy Efficiency Future Case 1 looked at the six area of the evolution of transportation energy use and resulting emissions broken into two categories. The first group of three is trends in the broader market over which the County has little influence, except by example in its own vehicle choices. The second group of three produces results largely driven by local policies and practices. The CES Assumptions in case are as follows:

1. Vehicles will use new material and manufacturing approaches resulting in reduced weight without loss of safety, comfort or style. In the next 20 years, weight reductions between 20 and 30% are anticipated yielding efficiency gains of between 15 and 20%[101]. In the modeling this is back-end loaded to reflect the industry's design cycles.
2. Vehicles with sophisticated energy management, clean diesel, diesel and gasoline hybrids and all electric technology are increasingly available, and by the end of the CES period at least a 30% increase in average efficiency will result[102].

[101] Multiple sources including Owens Corning Automotive Solutions confirm 10% weight reduction creates 7% fuel efficiency.
[102] See multiple manufacturers' performance specs for current and concept vehicles.

3. Independent of technical factors, the consumer's choice is moving to a different average mix of vehicles and is moving towards smaller SUV's, various crossovers, and more compact sedans. The traditional market for full size SUV's and trucks will continue to exist but as a smaller proportion of the total. This shift is being driven by a complex mix of demographics, concerns over fuel pricing, urban design, and environmental concerns. The CES team estimates that the combined effect of this trend will result in at least a further 15% fuel efficiency gain over the Plan period.
4. Loudoun plans to grow quality employment in the County faster than population. Over time, this shortens the average commuting distance, and reduces total energy needs. This could be as much as a 15% gain however a very conservative 5% was used in the CES assessment.
5. Two new metro stations will be opened in Loudoun, along with numerous transit initiatives for bus services both within the County and for commuting. These will be increasingly conveniently accessible as population densities to the east of the County increase. The combination of convenience and cost will increase transport energy efficiency by a further 10%.
6. Transit oriented developments with mixed-use, walkable neighborhoods are planned as a part of Loudoun's future. Denser development in general encourages walking, cycling and use of smaller vehicles. Recognizing this will be a relatively small part of the overall shape of the County, the transportation energy impact is estimated to be no more than 5% on energy use.

The CES Transportation Future Case 1 assumes the above efficiency gains are on the basis of energy use per vehicle mile travelled or avoided. It further assumes they are multiplicative not additive, and apply in sequence from 1 to 6.

The CES did not assume National or State policies driving widespread implementation of an infrastructure to create accelerated substitution of fossil fuel powered vehicles by electric vehicles.

3.1: Built Environment Energy Efficiency: Future Case 2

Given that a large part of Loudoun County is, and will remain, rural in nature, the CES included a case that was appropriate to this aspect of the County. This third future scenario builds on the assumptions of Case 1. Case 2 introduces energy efficiency and clean supply that are appropriate for stand-alone, low-density neighborhoods. It also assumes an aggressive deployment of Solar PV to reduce summer grid peak faster and deeper than in Case 1. In addition to all of the assumptions used in Case 1, Case 2 assumes the following:

1. 10% of new residential and non-residential buildings utilize biomass pellet or chip fuels for heating purposes
2. 10% of new residential buildings are using Solar thermal
3. An average 300 ft² of PV is installed on each new building - about 100 MW installed for the entire County

4. 20% of natural gas is replaced by gas derived from biomass[103]

Figure E.2 gives an indication of the best available data for today's bio waste potential[104].

Figure E.2: Bio Waste Potential Sources

Residue	Lo	Hi	County Average from Several Estimates in Bone Dry Tons	
Crop Residues				
Barley Straw	117	656	419	
Corn Stover	2,274	3,082	2,668	
Oat Straw	0	0	0	
Peanut Residue	0	0	0	
Sorghum Residue	0	0	0	
Soybean Residue	1,194	1,991	1,658	
Wheat Straw	620	2,594	1,294	
Animal Manures				
Horse Manure	5,461	20,848	11,806	
Dairy Manure	394	6,306	3,795	
Wood Waste				
Primary Forest Product Manufacturers	12,240	14,417	13,329	
Logging Residues	316	15,980	7,706	
Food Waste				
Post Consumer Food Waste	4,958	5,111	5,034	
Yellow Grease	1,158	1,321	1,001	
Brown Grease	1,745	2,608	2,212	
	30,477	74,914	50,922	
	4	kWh/kg		
	907	kg/ton		
		Low	110,571	
		High	271,788	
		Average	184,745	
		Gas estimation 2040 Future Case	3,000,000	MWh/yr

These potential sources are likely to be readily available both in the short and long-term. Collectively they could replace between 4 to 9% of the natural gas consumption estimated by the year 2040. These are classified as near-zero greenhouse gas for reporting purposes.

Other high low-impact energy sources that have not been evaluated are:

1. Using fallow land for "energy plants" (that is, fast growing woods)
2. Separate biogenic waste from normal waste for waste-to-energy purposes
3. Wood waste from neighboring Counties with higher ratio of woodland areas

Based on a superficial assessment[105], potentially replacing 20% of the County's 2040 natural gas needs by biogas or other forms of biogenic fuel seems to be a realistic and probably cost-effective scenario. Further detailed assessments are needed.

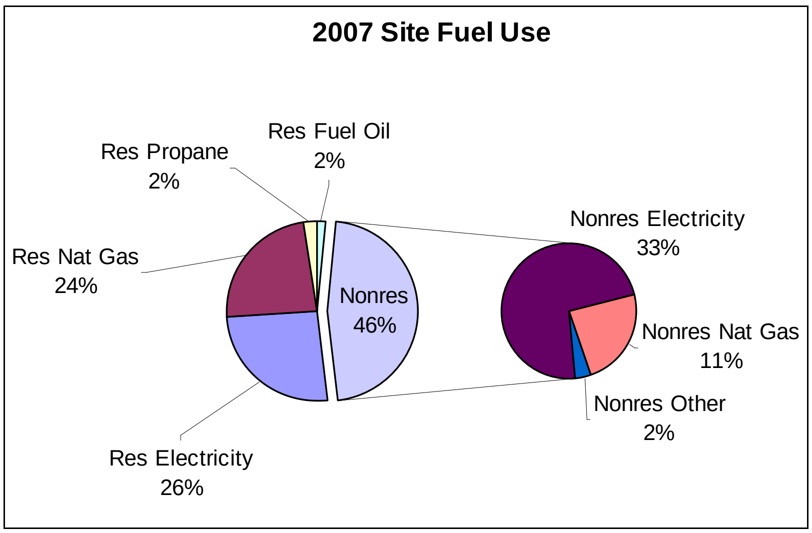
[103] Several sources are possible, in principle biological substances from waste to wood. For example 90% maize and 10% animal excrement would need an agricultural area of 63 km² or 5% of County area.
[104] Estimates from multiple State and County sources
[105] Estimates from MVV decon GmbH – a major operator of biomass, biogas and waste to energy facilities in EU

Appendix F: Energy Baseline at 2007 - Statistical Information

Built Infrastructure – 2007

The sectors used for benchmarking are residential buildings and non-residential buildings, which includes commercial, institutional and industrial. Relative to all other sectors, the industrial component of Loudoun's energy use is small. Actual delivered site energy consumption data (see Figure F.1) was provided by Dominion Virginia Power, Northern Virginia Electric Cooperative (NOVEC) and Washington Gas Light Co., with estimates provided for other fuels (propane and fuel oil). Note that the residential sector is the slightly larger consumer of site energy, using 54% of all delivered energy, and with non-residential consuming 46%.

Figure F.1: Loudoun County Delivered Electricity, Natural Gas and other Fuel Consumption for 2007[106]



Residential

Figure F.2: Loudoun County Residential Buildings

Detached, Attached and Multi-family.

[106] Metered consumption for eight Tax Districts within Loudoun County provided by Dominion Virginia Power, NOVEC, and Washington Gas.

Figure F.3 (below) summarizes estimates of the existing housing stock, which consists of 101,359 units with 159 million square feet of conditioned space. More than 40% of units were built after the year 2000, with the majority of units built between 1990 and 2007. The type of unit has also shifted from almost exclusively detached housing prior to 1960, to a substantial share of attached (29%) and multi-family (16%) units in 2007. Even with this shift, however, detached housing still dominates overall net area of all residential units at 103 million square feet.

Of the 101,000 units in 2007, the Census Bureau estimates that 87.6% are occupied[107].

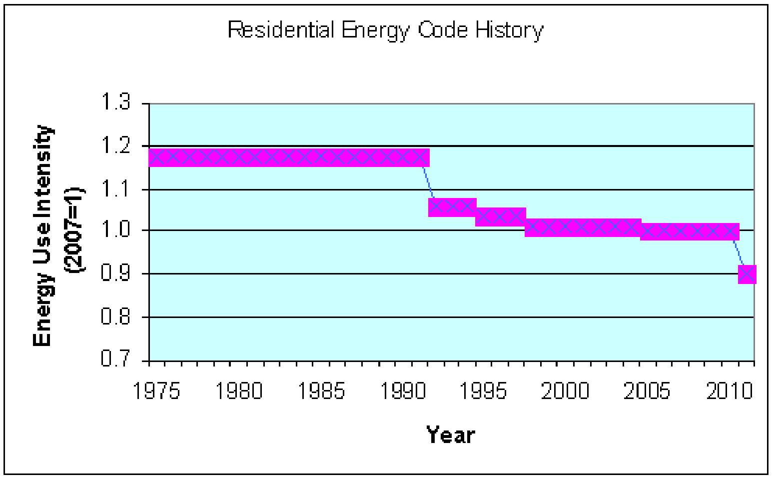
Figure F.3: Loudoun County Housing Stock and Area Estimates[108, 109]

Housing Type	Prior to 1960	1960-1969	1970-1979	1980-1989	1990-1999	2000-2007	Total Units	Occupied Units	Total Estimated Net Area
Detached	3,443	3,284	5,118	7,506	14,837	20,974	55,161	48,321	102,980,347
Attached	34	177	1,627	3,349	11,369	13,070	29,626	25,952	36,892,109
Multi-family	17	708	1,682	2,953	4,178	7,034	16,572	14,517	18,862,492
Total	3,494	4,169	8,427	13,808	30,384	41,077	101,359	88,790	158,734,949
Fraction	3%	4%	8%	14%	30%	41%	100%		

Even with the recent growth in construction of housing, there are still about 60% of units that were built prior to the year 2000. With this age of buildings and the type of components likely used, the opportunity exists for major energy retrofits and renovations throughout the planning period.

107 http://fastfacts.census.gov/servlet/ACSSAFFFacts?geo_id=05000US51107&_state=04000US51&pctxt=cr
108 2007 Detached, Attached and Multi-family unit estimates from the 2008 Growth Plan http://biz.loudoun.gov/Portals/0/PDF/growth/growth_summary_2008/a3a.pdf
109 Unit count estimates in each decade and unit total area derived from the Loudoun County Residential Property Database, with assumptions on unconditioned area including data derived from 2005 EIA reporting http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/hcfloorspace/pdf/tablehc1.1.2.pdf.

Figure F.4: Residential Energy Code Comparison[110]



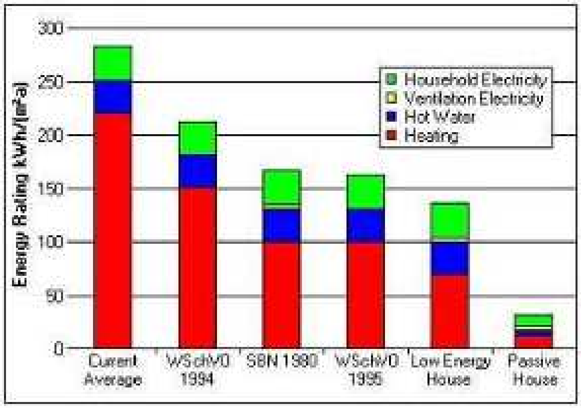
One indicator of energy use in existing homes is the energy code in place when the home was built. Figure F.4 shows approximate differences from improvements in the leading national residential energy efficiency code starting in 1975. The first residential energy code was ASHRAE Standard 90-75. In 1983, the Model Energy Code (MEC) was issued, which became the International Energy Conservation Code (IECC) in 1998. Virginia is currently using the 2006 IECC for the residential building energy code, and will likely adopt the 2009 IECC in 2011.

Figure F.3 compares past versions to a base year of 2007, and includes the end-uses addressed by the code, namely heating, cooling, and domestic water heating. It does not address total energy use, which would include appliances and other plug loads. The US Department of Energy estimates[111] that the 2006 IECC today is about a 14% reduction in code related energy from the 1970s. It is clear that homes built prior to 2000 are high priority candidates for renovation, especially those prior to 1995. In addition to lighting upgrades and appliance or equipment replacements, energy improvements can include envelope changes such as air sealing, window replacement and added insulation, and programmable thermostats.

As a comparison, Figure F.5 indicates the evolution of residential energy codes in energy use per square meter in Germany and Sweden.

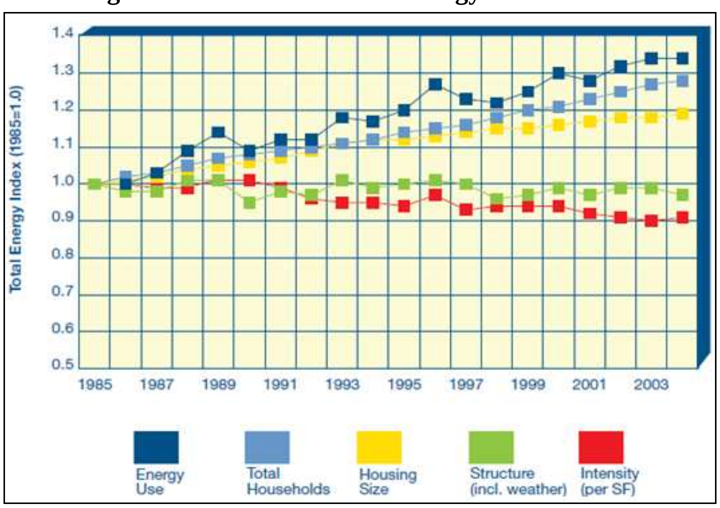
[110] Owens Corning Science and Technology, LLC
[111] http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/bt_stateindustry.pdf

Figure F.5: Residential Energy Intensity Evolution - Germany



The bar on the left is the current average for all buildings, and roughly represents the code from about 1985. The next bar is the 1994 German National Code. The bar, SBN 1980, represents the Swedish Code for 1980, showing the very large gap that existed between Scandinavia and the rest of the world at that time. Germany matched this level in 1996, shown in the next column. The column marked "low-energy house" is a current voluntary level, similar to Energy Star, but at much higher efficiencies. The last column is the so called "Zero-Net Energy or "Passive" standard that is becoming established but is not yet in any codes.

Figure F.6: US Residential Energy Indicators[112]

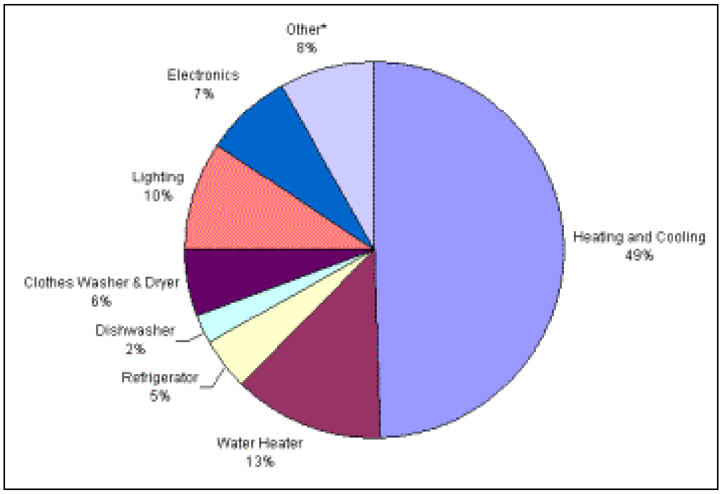


It is also important to look at total energy per household. Figure F.6 from the US Department of Energy displays total energy consumption, number of households, house size, and energy intensity over the period from 1985 to 2004. The energy intensity index, based on energy use per square foot, has generally trended downward since 1985. However, the number of

[112] ibid

households increased over this period by 28 percent, house size rose and energy consumption (including electricity losses) increased overall by about 34%.

Figure F.7: US Average Residential Energy by End Use[113]



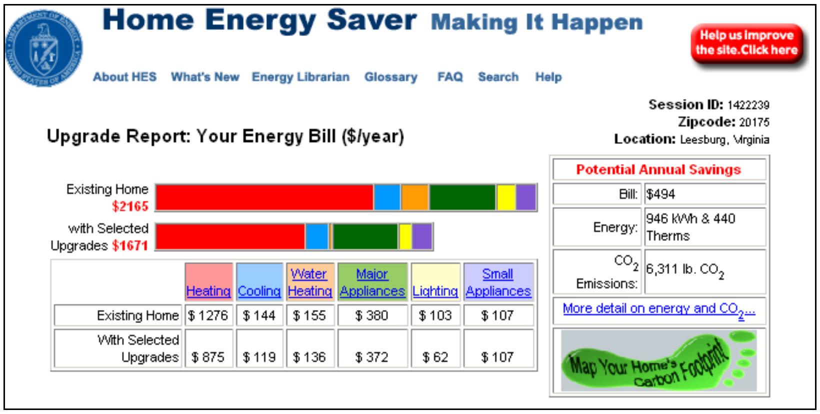
Residential energy use can be characterized by major uses of space heating, space cooling, water heating, appliances, lighting and plug loads. Figure F.7 shows residential energy use and where energy is typically used. The significance of space heating and cooling load is clear, dominating consumption. The second largest use is water heating.

Improvements in home energy efficiency can be determined with readily available programs, such as the Home Energy Saver calculator. Figure F.8 (below) shows what a home in Leesburg might save. For this example, the choices were:

- Seal the ducts professionally to reduce leakage
- Install a programmable thermostat
- When replacing the dishwasher, choose an ENERGY STAR-labeled model
- Replace high-use incandescent lamps with compact fluorescent lamps
- Have a professional seal the home for air leaks
- When replacing the gas furnace, choose an ENERGY STAR-labeled model
- Increase attic insulation to R-38

[113] Virginia Department of Mines, Minerals and Energy http://www.dmme.virginia.gov/DE/RelatedProgs/energystar.shtml#Residential

Figure F.8: Example Home Energy Savings Analysis[114]



For these improvements, the annual utility bill savings are about $494 at an estimated investment of $2,890, giving an estimated return on investment of 17%, or a simple payback in 6 years. These are significant savings that are attainable without applying incentives and possible income tax benefits. These measures would also reduce greenhouse gas emissions by about 3 mt per year.

The estimated energy use for Loudoun County's homes by fuel source is shown in Figure F.9 along with US benchmarks based on unit, area, and capita.

Figure F.9: Residential Benchmark Comparison**

Residential Benchmarks								
	Total Use Energy		Energy Use per Occupied Unit		Energy Use per Area		Energy Use per Capita	
Energy Source	**MMBTU/year**	**MWhe/year**	**MMBTU/ unit/year**	**MWhe/ unit/year**	**BTU/ ft2/year**	**kWhe/ m2/year**	**MMBTU/ capita**	**MWhe/ capita**
Electricity	5,499,959	1,611,879	61.9	18.2	34,649	109	20.3	5.9
Natural Gas	4,623,276	1,354,948	52.1	15.3	29,126	92	17.0	5.0
Propane	520,146	152,440	5.9	1.7	3,277	10	1.9	0.6
Heating Oil	342,586	100,402	3.9	1.1	2,158	7	1.3	0.4
Loudoun County Site Total	10,985,966	3,219,669	124	36.3	69,209	218	40.5	11.9
U.S. Residential Site Total			95.0	27.9	58,745	185		
Indirects	12,833,237	3,761,050	145	42.4	80,847	291	47.3	13.9
Loudoun Total	23,819,203	6,980,719	268	78.6	150,056	509	88	25.7

**Includes utility data and electricity conversion indirect energy. Propane & fuel oil were estimated based on US Census data on residential heating fuel information. US data from EIA[115]

[114] DOE Home Energy Saver http://hes.lbl.gov/
[115] Energy Information Administration http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/c&e/pdf/alltablesus1-15.pdf

Non-Residential

Figure F.10: Loudoun County Non-Residential Buildings

Office, Data Center and Retail

At the total county level, there was no metered energy data available to the CES team separated by user type. This is clearly available with the utilities, but need client approval to release. The one exception was the energy use data from Loudoun County Public Schools and from the County's own facilities. This data accounted for a relatively minor percentage (7%) of the energy use in the non-residential sector.

County Owned Assets

Both the County and the public schools have undertaken programs to reduce energy use in their buildings.

Loudoun County Public Schools (LCPS) has had an extensive energy conservation program since 1992. This 15 year effort has resulted in a total of $31,000,000 cost avoidance to the County. The program is an excellent example of the benefits of energy efficiency. It also highlights the need for focused, sustained energy management or stewardship. Becoming an Energy Star partner in 1998, LCPS has certified 23 of their buildings as Energy Star certified buildings. By investing $1.9 million dollars in energy efficiency improvements for Meadowland Elementary School, they have achieved maximum comfort for the learning environment while improving energy performance.

Loudoun County has created a solid foundation for integrating energy awareness and management into the County's culture and operation, and by example, encouraging energy conservation as a community-wide goal. The energy ad-hoc committee was created in 2008, which became a permanent committee in 2009. In 2008, the County and the schools participated in the Virginia Municipal League (VML) challenge. By receiving 185 points out of 200, it received first place cash award along with the Cool County Certificate. The County doubled its Cool Capital Challenge goal from 1.365 million pounds (620 metric tons) of carbon emission reduction to 2.623 million pounds (1,311 metric tons), a 6% reduction. The County has an active energy committee which consists of liaisons from all the departments. As a result of their efforts, the County has reduced its electrical usage by 386,000 kWh in fiscal year 2009.

The County has performed energy audits of all the County buildings and it is in the process of implementing its energy saving recommendations in the near future.

Non-Residential Buildings in Loudoun County

Information on building categories is in Figure F.11. Included in the 69 million square feet of buildings are 3,177,215 square feet of Data Centers; generally a large consumer of electricity.

Figure F.11: Loudoun County Non-Residential Buildings Data[116]

Planning Subarea	Office	Industrial	Retail	Other*	Total
Ashburn	8,486,305	11,030,551	2,468,041	6,918,879	28,903,775
Dulles	769,520	2,372,108	1,172,771	2,663,895	6,978,294
Leesburg	2,094,716	740,075	3,587,023	3,555,769	9,977,584
Northwest	4,398	23,103	32,915	241,812	302,228
Potomac	580,084	119,656	1,083,359	1,808,262	3,591,361
Route 15 North	1,008	7,361	7,361	93,192	108,922
Route 15 South	0	14,709	21,303	74,624	110,637
Route 7 West	156,193	429,855	451,047	1,534,517	2,571,612
Southwest	95,995	17,803	362,131	245,920	721,850
Sterling	3,022,209	5,781,382	3,744,519	3,654,656	16,202,767
Total	15,210,429	20,536,603	12,930,470	20,791,527	69,469,028

* Includes schools, hospitals, churches, airport support facilities, self storage, etc.

As with residential, an indicator of energy use for existing non-residential buildings would be the energy code in place when the building was built.

[116] Loudoun County Growth Plan.

Figure F.12: Non-Residential Energy Code Comparison[117]

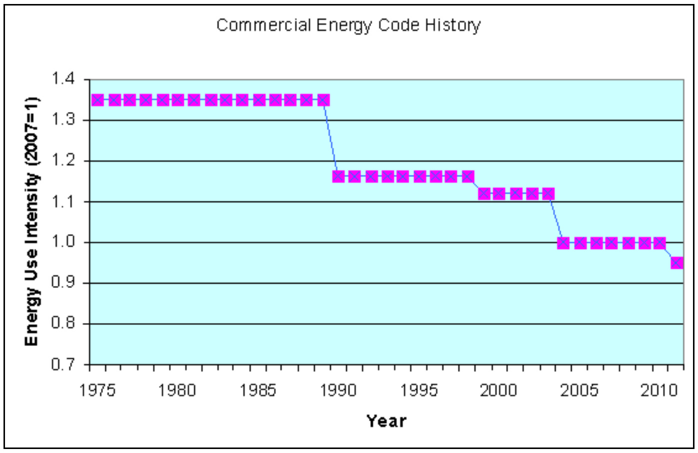
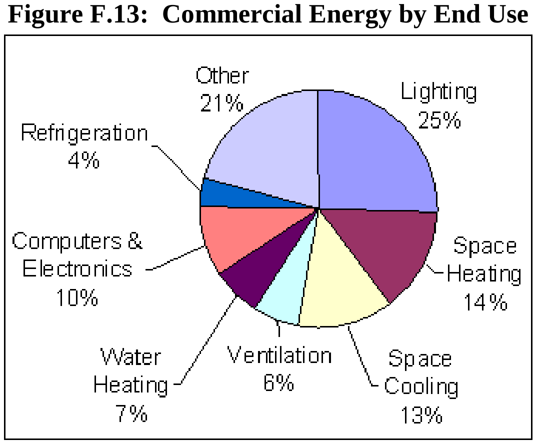


Figure F.12 shows the history of US commercial energy codes, from the first non-residential code, ASHRAE Standard 90-75, followed by various versions ending with the current ASHRAE Standard 90.1-2004. Virginia is currently uses Standard 90.1-2004 which is a part of the 2006 IECC, and will likely adopt the 2009 IECC in 2011, which incorporates Standard 90.1-2007.

The US Department of Energy estimates[118] that Standard 90.1-2004 today is about a 25% reduction in code regulated energy from the 1970s. What becomes apparent is that buildings built prior to the year 2004 are all candidates for renovation, and especially those prior to 1990. In addition to lighting upgrades, improved controls and equipment replacement, energy improvements can include envelope changes such as air sealing, window treatment/replacement and added insulation. Increasingly, on-site energy supply options from clean and renewable sources are considered as the costs risk of energy rise, and technology becomes cheaper.

Figure F.13: Commercial Energy by End Use



[117] Owens Corning Science and Technology, LLC
[118] http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/bt_stateindustry.pdf

According to the Energy Information Administration[119], energy use across the stock of US commercial buildings is shown in Figure F.13. Lighting is the largest component at 25%, with space heating and cooling making up another 27%. Computers and electronics consume about 10%, while water heating is another 7%. The "Other" category includes cooking, service station equipment, ATM machines, medical equipment, and telecommunications equipment.

It should be remembered that this breakdown does not include electrical conversion energy, so the real energy used is more than double that indicated for everything except space and water heating.

National and regional data is available for commercial building energy consumption by main building activity. Figure F.14 lists commercial energy use by building and by square foot.

Figure F.14: US Data on Commercial Building Site Energy Consumption[120]

Principal Building Activity	U.S. National Data			South Atlantic
	Floorspace per Building	Energy Use per Building	Energy Use per Sq. Ft.	Energy Use per Sq. Ft.
	1000's Sq. Ft.	MMBtu	MBtu	MBtu
Education	25.6	2,125	83.1	80.9
Food Sales	5.6	1,110	199.7	Q
Food Service	5.6	1,436	258.3	259.2
Health Care	24.6	4,612	187.7	160.1
Inpatient	241.4	60,152	249.2	Q
Outpatient	10.4	985	94.6	Q
Lodging	35.8	3,578	100.0	96.8
Retail (Other Than Mall)	9.7	720	73.9	73.4
Office	14.8	1,376	92.9	79.3
Public Assembly	14.2	1,338	93.9	94.3
Public Order and Safety	15.5	1,791	115.8	Q
Religious Worship	10.1	440	43.5	39.6
Service	6.5	501	77.0	73.5
Warehouse and Storage	16.9	764	45.2	35.7
Other	21.9	3,600	164.4	Q
All Non-Mall Buildings	13.9	1,253	89.8	83.4

Q means data not reliable and is withheld

Non-residential energy consumption for all of Loudoun County is shown in Figure F.15 (below). Data were not consistently available by building type or by end use categories, so the energy

[119] http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/bt_stateindustry.pdf
[120] http://www.eia.doe.gov/emeu/cbecs/cbecs2003/

source usage is only for the total non-residential category. Any analysis of industrial energy use should focus at the level of a specific industry, company or process type. It is interesting to note that the national data does not yet call-out Data Centers as a distinct category, despite the fact that is one of the fastest growing electricity uses.

Figure F-15 summarizes the available non-residential baseline data for Loudoun County.

The Team suggests immediately establishing tracking indexes for the County owned properties and for the total non-residential buildings inventory based on total energy use, energy use per square foot, total GHG and GHG per square foot. These indexes will be the starting point for monitoring commercial energy intensity of the County, itself correlated to the overall employment and other economic activity of the County. As the data quality and tracking ability grows, the data can migrate to indexes that could relate the County GDP, employment and commercial tax base to energy use and climate change impact.

Figure F.15: Loudoun County - Non-Residential Energy Benchmark Comparison**

Non-Residential Benchmarks							
		Total Use Energy		Energy Use per Area		Energy Use per Capita	
Area	Energy Source	MMBTU/year	MWhe/year	BTU/ ft2/year	kWhe/ m2/year	MMBTU/ capita	MWhe/ capita
Community	Electricity	6,895,300	2,020,813	113,964	360		
	Natural Gas	1,934,449	566,931	31,972	101		
	Propane	231,627	67,883	3,828	12.1		
	Heating Oil	126,259	37,003	2,087	6.6		
	All Fuels	9,187,635	2,692,630	151,851	479		
Schools & County Facilities	Electricity	452,043	132,481	50,426	159		
	Natural Gas	196,179	57,494	21,884	69.0		
	Propane	8,081	2,368	901	2.8		
	Heating Oil	31,621	9,267	3,527	11.1		
	All Fuels	687,924	201,611	76,738	242		
All Buildings Site Total	Electricity	7,347,343	2,153,293	105,764	334	27.1	7.9
	Natural Gas	2,130,628	624,425	30,670	96.8	7.9	2.3
	Propane	239,708	70,252	3,451	10.9	0.9	0.3
	Heating Oil	157,880	46,270	2,273	7.2	0.6	0.2
	All Fuels	9,875,559	2,894,240	142,158	448	36.4	10.7
Indirects		17,143,801	5,024,351	246,783	779	63.2	18.5
Total		27,019,360	7,918,591	388,941	1,227	99.6	29.2

**Includes school, County and utility data, plus electricity conversion indirect energy. Propane & fuel oil were estimated based on US Census data.

Transportation

Baseline

The use of light vehicles (cars, light trucks, SUVs and minivans) by residents of Loudoun

County is 28% of the total energy used by the county; less than both residential and non-residential uses if conversion energy is included. However, at 36% of the total greenhouse gas emissions of the County, is the single largest contributor. For work commuting, single occupancy vehicles are the overwhelming choice. For school commuting, student driving, being a passenger, or taking a school bus are the most used options. Walking and biking are very low percentage choices.

GHG Emissions

The baseline year selected for greenhouse gases attributable to transportation is 2008 due to availability of data. The baseline for Loudoun County is 5.16 metric tons per capita. The US national benchmark for emissions from heavy trucking at 1.43 mt per capita has been included in this total. The reason this is included is that the County has no interstate highways and thus the vehicle miles traveled (VMT) statistics are understated. Similarly, emissions attributable to non-road activity would also need to be added in to the Loudoun County total for complete comparability with the US overall index. The US national average for non-road activity (recreational boats and ships, aircraft related, electrical – rail, residual fuel oil, natural gas & LPG) is 0.98 mt per capita. Added to Loudoun, then the transportation baseline for all modes is calculated to be 6.14 mt per capita. This is 7% less than the 6.63 mt/capita national average greenhouse gas emissions for road transportation (see Figure F.16)

Figure F.16: Breakdown of US Transportation Sector GHG emissions, 2007[121]

Transportation Sector - Emissions (in Tg Co2e) Detailed by Transport Mode

	Gasoline	Diesel	Other	Totals	%	mt / capita
Road Vehicles						
Passenger Cars	620.9	4.1			33.0%	2.19
Light Duty Trucks	493.9	26.9			27.5%	1.82
Medium and Heavy Duty Trucks	35.6	371.3			21.5%	1.43
Buses	0.4	10.9			0.6%	0.04
Motorcycles	2.0	46.0			2.5%	0.17
Sub-total Road	1,152.9	459.2		1,612.1	85.2%	5.65
Non – Road Transport						
Recreational Boats and Ships	13.8	11.4		25.2		
Aircraft Related			187.5	187.5		
Rail - Electricity			4.8	4.8		
Residual Fuel Oil, Natural Gas & LPG			62.6	62.6		
Sub-total Non - Road				280.1	14.8%	0.98
Total All Modes - Road and Non-Road				1,892.2	100.0%	6.63
International Bunkers *(normally excluded)				107.9		
Total (Including Bunkers				2,000.1		

This is largely attributable to above average miles travelled by cars as opposed to light trucks, SUVs and minivan. In Loudon cars are over 80 % of light vehicle mileage, nationally this is closer to 60%.

On a per mile basis, Loudoun County's light vehicle GHG emissions are about 430 grams/mile (270 grams/kilometer). The equivalent US national levels are very similar, indicating that inefficiency due to congestion is eroding the efficiency advantage that Loudoun has due to

[121] p. 3-12 Energy Section EPA US GHG Inventory Report, 2007, http://epa.gov/climatechange/emissions/usinventoryreport.html

vehicle mix. The new US CAFE Fuel Economy Standards[122] will reduce current levels by about 17% for new vehicles produced from 2016 onwards; this will be fully reflected in the total fleet about a decade later where levels of about 360g/mile (220 g/km) can be expected.

As a comparison, the EU current average is about 290 g/mile (180 g/km), with a current target to reduce this to about 210 g/mile (130 g/km). The new fleet average, roughly the equivalent of the US CAFE standards, must reach this level by 2015[123]. The stretch target is 120 g/km by 2012 for new cars. The longer term target is to aim for ultra-low-emissions standards below 100 g/km. A handful of cars, such as the VW Diesel Polo, and soon to be released diesel/electric hybrids can meet this level today.

122 http://www.nhtsa.dot.gov/portal/fueleconomy.jsp
123 http://ec.europa.eu/environment/air/transport/co2/co2_home.htm

2007 Baseline Energy and Greenhouse Gas Data

Energy Use by Sector

	Energy MMBtu	Energy %sub-total	Energy % total	GHG mt	GHG %sub-total	GHG % total	Energy MMBtu/capit	GHG mt/capita
Residential-Direct	10,985,966	31.2%	15.5%	1,174,504	33.9%	30.5%	40.5	4.33
Non-Residential-Direct	9,875,559	28.1%	14.0%	1,276,119	36.9%	33.1%	36.4	4.71
Transportation-Local	14,303,862	40.7%	20.2%	1,011,643	29.2%	26.3%	52.7	3.73
County Total-Direct	***35,165,387***	***100.0%***	***49.7%***	***3,462,266***	***100.0%***	***89.9%***	***129.7***	***12.77***
Residential-indirect	12,833,237	36.1%	18.1%	0	0.0%	0.0%	47.3	0.00
Non-Residential-indirect	17,143,801	48.2%	24.2%	0	0.0%	0.0%	63.2	0.00
Trucking - Indirect	5,610,186	15.8%	7.9%	387,783	100.0%	10.1%	20.7	1.43
County Total-Indirect	***35,587,224***	***100.0%***	***50.3%***	***387,783***	***100.0%***	***10.1%***	***131.2***	***1.43***
Residential-Total	23,819,204	33.7%	33.7%	1,174,504	30.5%	30.5%	87.8	4.33
Non-Residential-Total	27,019,360	38.2%	38.2%	1,276,119	33.1%	33.1%	99.6	4.71
Transportation-Total	19,914,048	28.1%	28.1%	1,399,426	36.3%	36.3%	73.4	5.16
County Total	***70,752,611***	***100.0%***	***100.0%***	***3,850,049***	***100.0%***	***100.0%***	***260.9***	***14.20***

2007 Total Energy Use by Sector in American Units

	Energy MWhe	Energy %sub-total	Energy % total	GHG mt	GHG %sub-total	GHG % total	Energy MWh/capita	GHG mt/capita
Residential-Direct	3,219,669	31.2%	15.5%	1,174,504	33.9%	30.5%	11.9	4.33
Non-Residential-Direct	2,894,240	28.1%	14.0%	1,276,119	36.9%	33.1%	10.7	4.71
Transportation-Local	4,192,048	40.7%	20.2%	1,011,643	29.2%	26.3%	15.5	3.73
County Total-Direct	***10,305,956***	***100.0%***	***49.7%***	***3,462,266***	***100.0%***	***89.9%***	***38.0***	***12.77***
Residential-indirect	3,761,050	36.1%	18.1%	0	0.0%	0.0%	13.9	0.00
Non-Residential-indirect	5,024,351	48.2%	24.2%	0	0.0%	0.0%	18.5	0.00
Trucking - Indirect	1,644,183	15.8%	7.9%	387,783	100.0%	10.1%	6.1	1.43
County Total-Indirect	***10,429,585***	***100%***	***50.3%***	***387,783***	***100%***	***10.1%***	***38.5***	***1.43***
Residential-Total	6,980,719	33.7%	33.7%	1,174,504	30.5%	30.5%	25.7	4.33
Non-Residential-Total	7,918,592	38.2%	38.2%	1,276,119	33.1%	33.1%	29.2	4.71
Transportation-Total	5,836,231	28.1%	28.1%	1,399,426	36.3%	36.3%	21.5	5.16
County Total	***20,735,541***	***100%***	***100.0%***	***3,850,049***	***100.0%***	***100.0%***	***76.5***	***14.20***

2007 Total Energy Use by Sector in ISO Units

Energy Use by Source

	Energy MMBtu	Energy %sub-total	Energy % total	GHG mt	GHG %sub-total	GHG % total	Energy MMBtu/capit	GHG mt/capita
Electricity	12,847,302	36.5%	18.2%	1,961,655	56.7%	51.0%	75.3	7.23
Natural Gas	6,753,903	19.2%	9.5%	397,854	11.5%	10.3%	39.6	1.47
Propane	759,854	2.2%	1.1%	51,219	1.5%	1.3%	4.5	0.19
Heating oil	500,467	1.4%	0.7%	39,895	1.2%	1.0%	2.9	0.15
Transport - Diesel	582,504	1.7%	0.8%	40,263	1.2%	1.0%	3.4	0.15
Transport - Gasoline	13,721,358	39.0%	19.4%	971,380	28.1%	25.2%	80.4	3.58
County Total Direct	***35,165,387***	***100.0%***	***49.7%***	***3,462,266***	***100.0%***	***89.9%***	***206.0***	***12.77***
Electricity conversion	29,977,038	84.2%	42.4%	0	0.0%	0.0%	175.6	0.00
Trucking - Diesel	5,610,186	15.8%	7.9%	387,783	100.0%	10.1%	32.9	1.43
County Total-Indirect	***35,587,224***	***100.0%***	***50.3%***	***387,783***	***100.0%***	***10.1%***	***208.5***	***1.43***
County Total	***70,752,611***		***100.0%***	***3,850,049***		***100.0%***	***414.4***	***14.20***

2007 Total Energy Use by Source in American Units

	Energy MWhe	Energy %sub-total	Energy % total	GHG mt	GHG %sub-total	GHG % total	Energy MWh/capita	GHG mt/capita
Electricity	3,765,172	36.5%	18.2%	1,961,655	56.7%	51.0%	13.9	7.23
Natural Gas	1,979,373	19.2%	9.5%	397,854	11.5%	10.3%	7.3	1.47
Propane	222,691	2.2%	1.1%	51,219	1.5%	1.3%	0.8	0.19
Heating oil	146,672	1.4%	0.7%	39,895	1.2%	1.0%	0.5	0.15
Transport - Diesel	170,715	1.7%	0.8%	40,263	1.2%	1.0%	0.6	0.15
Transport - Gasoline	4,021,333	39.0%	19.4%	971,380	28.1%	25.2%	14.8	3.58
County Total Direct	***10,305,956***	***100.0%***	***49.7%***	***3,462,266***	***100.0%***	***89.9%***	***38.0***	***12.77***
Electricity conversion	8,785,402	84.2%	42.4%	0	0.0%	0.0%	32.4	0.00
Trucking - Diesel	1,644,183	15.8%	7.9%	387,783	100.0%	10.1%	6.1	1.43
County Total-Indirect	***10,429,585***	***100.0%***	***50.3%***	***387,783***	***100.0%***	***10.1%***	***38.5***	***1.43***
County Total	***20,735,541***		***100.0%***	***3,850,049***		***100.0%***	***76.5***	***14.20***

2007 Total Energy Use by Source in ISO Units

Transportation Energy and Greenhouse Gas

	Distance veh/mile (k)	Energy MMBtue	GHG mt	Energy MBtue/mile	GHG g/mile	GHG mt/capita
Cars	1,901,257	11,124,327	787,371	5.85	414	2.90
Light Trucks and SUV	383,166	2,828,550	199,948	7.38	522	0.74
Motorcycles	5,862	13,737	972	2.34	166	0.00
Buses	12,722	337,248	23,352	26.51	1,836	0.09
Heavy Trucking (allocated)	219,472	5,610,186	387,783	25.56	1,767	1.43
Total	***2,522,480***	***19,914,048***	***1,399,426***	***7,895***	***555***	5.16

2007 Total Energy Use by Vehicle Type in American Units

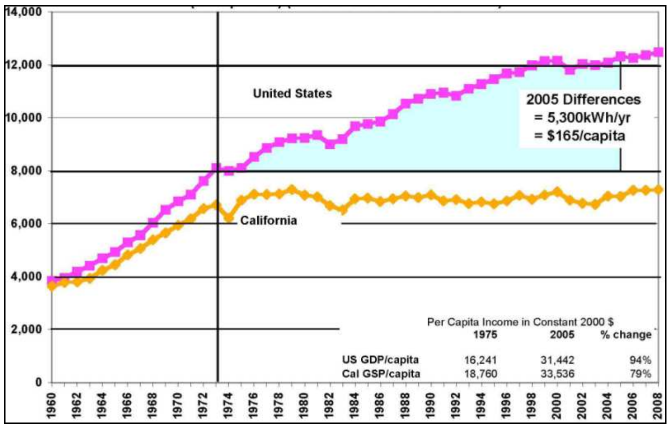
	Distance veh/km (k)	Energy MWhe	GHG mt	Energy kWh/km	GHG g/km	GHG mt/capita
Cars	3,059,123	3,260,218	787,371	1.07	257	2.90
Light Trucks and SUV	616,515	828,966	199,948	1.34	324	0.74
Motorcycles	9,432	4,026	972	0.43	103	0.00
Buses	20,469	98,838	23,352	4.83	1,141	0.09
Heavy Trucking (allocated)	353,131	1,644,183	387,783	4.66	1,098	1.43
Total	***4,058,670***	***5,836,231***	***1,399,426***	***1,438***	***345***	5.16

2007 Transportation Energy Use by Source in ISO Units

Benchmarking California Electricity Intensity

As an interesting piece of benchmarking, California has been of the few parts of the USA to have decoupled electricity use from GDP growth. Through consistently higher construction, lighting and appliance standards than the rest of the USA, the have succeeded in keeping the

Figure F.17: California Per Capita Electricity Use 1960 to 2008



electricity use per head constant since about 1975 despite GDP nearly doubling over this time.

Figure F.17 shows per capita electricity sales, not including self-generation, in kWh/person. The impact of long term focus on energy conservation is evident in the flat usage over the last 3 decades, compared to the rest of the U.S.

Appendix G: Energy Use and Efficiencies in Transportation

Transportation Efficiencies

Figure G.1: Automobile Mobility: Expectation[124] vs. Reality[125]

Transportation is a high-priority focus for Loudoun County. The Loudoun County-wide Transit Plan and Northern Virginia TransAction 2030 plans address how Loudoun intends to serve the mobility needs of its constituents over the next 20-30 years. However, more action is needed in order to achieve the energy demand and corresponding GHG reductions desired. These plans should be updated to integrate the energy and greenhouse gas objectives from the CES. The CES has recommended transportation strategies that will reduce GHG emissions from transportation to 2.77 mt CO_2e per capita by 2040. Many of the strategies contained in the CES will be implemented via a mix of community outreach and various ordinances favoring less polluting transportation.

The following major factors will reduce transportation emissions:

- material technology lowering vehicle weight over the next 10 to 15 years
- penetration of clean diesel, electric vehicles and hybrids
- consumers choosing smaller vehicles

[124] CTP01Feb07_Bulletin.pdf
[125] Scientific American article May 19, 2009 “New US Vehicle Standards Address Fuel Economy and Greenhouse Gas Emissions” by Josh Voorhees and Robin Bravender, http://www.scientificamerican.com/article.cfm?id=new-us-fuel-economy-standards

- balancing the live / work ratio - local employment cutting outbound commuting and more affordable housing allowing workers to move closer to employment locations and thereby decreasing inbound commuting
- Transportation Oriented Development focused on the forthcoming MetroRail stations (Route 606 Loudoun Parkway and 772 Moorefield Station) along with transit links to existing MetroRail stations that increase commuting use of mass transit percentage
- increase in "active transport" by creating more walkable neighborhoods and eliminating vehicle use
- densification of neighborhoods encouraging walking, two-wheelers and small EV's/Smart Car type vehicles

Changes in Commuting Transport Mode

Figure G.2: Spadina Line, Toronto Above-ground Subway[126]

Figure G.3: Toronto Light Rapid Transit Spadina Line[127]

Figure G.4: Bordeaux, France Tramway[128]

Commuters could use existing corridors as locations for rapid public transit routes including integration of rail and dedicated bus lanes (especially in the interim until rail lines are built). These existing corridors can incorporate parallel rail lines as seen in the Toronto Spadina Subway line (Canada) and Bordeaux Tramway (France) – see Figures G.2 to G.4 above.

Loudoun County Transportation corridors include: Route 28, 7, 625 (Waxpool Road), 607 (Loudoun County Parkway), 606 (Old Ox Road), 50 and Dulles Greenway (see Figure G.5).

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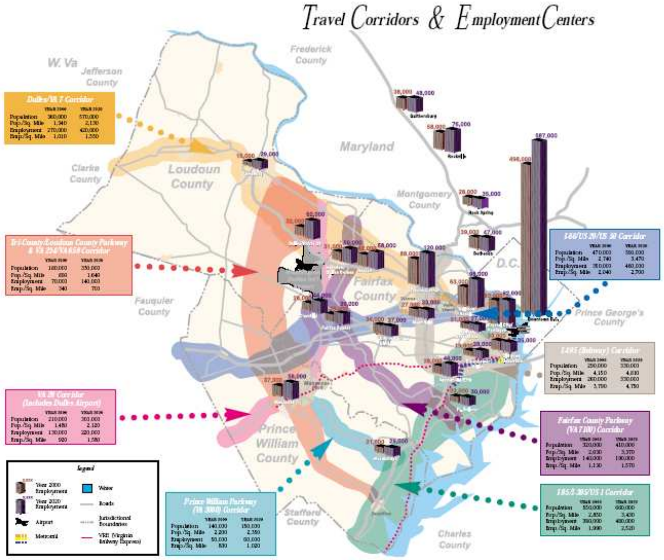
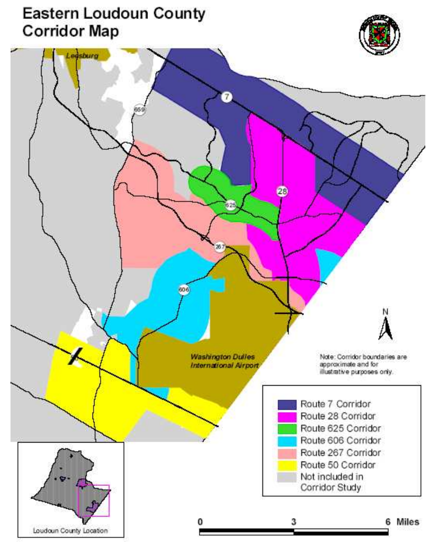
126 Toronto, TTC Yonge/University/Spadina Subway Line at Eglinton West Station. Source: Rob Hutchinson, 7/27/2002 http://world.nycsubway.org/perl/show?31668. Southbound train in the median of Allen Rd. The road was closed to cars this day so that pilgrims could use it to walk to the papal mass near Downsview Stn. Glencairn station is visible in the background.

127 Toronto Light Rapid Transit (LRT) Line looking west from Spadina Avenue. Expected ridership is 6.6 million riders per year. Source: James Bow http://transit.toronto.on.ca/images/streetcar-4007-19.jpg

128 Bordeaux tram using APS on route B near the Roustaing tramstop. Source: S P Smiler, Summer 2006 http://en.wikipedia.org/wiki/File:Bordeaux-tram-aps-near-Roustaing.jpg

Figure G.5: Loudoun County Transportation Corridors[129]





Dulles Greenway[130] - integrated rail

The densification of Leesburg, and the development of Transportation Oriented Development villages at Moorefield Station and One Loudoun (Dulles Greenway at Routes 606 and 772), combined with accelerated development of bus, light-rail along established corridors, and improved frequency and access to MetroRail will shift the ratio to approximately 50% of commutes (Intra-County, Inter-County and Through-County) via mass transit. Assuming reasonable load factors, the CO_2 per passenger mile for the mass transit content will be 20% (one-fifth) of the level of the equivalent journey by individual vehicle. On average, a commuting passenger mile will now contribute 73 g/mi. The effectiveness of this strategy is hindered with the length of construction and time to complete the new Loudoun stations. As a result, factored for all journeys, the average rises to a 6% reduction. This reduction could be increased with enhanced bus service to begin immediately.

[129] Travel Corridors and Employment Centers Map: 2020 Plan. Eastern Loudoun County Corridor Map http://biz.loudoun.gov/Home/FactsStatsandMaps/tabid/60/Default.aspx
[130] http://www.dullesgreenway.com and http://www.mwaa.com/tollroad

Changes in Intra-, Inter- and Through-County Commuting Mix

Reduce the demand on the Loudoun County transportation system via an improved jobs / housing balance. Today 80% of all Loudoun County residents' travel is related to commuting. The average commute is 25 miles each way. (The average Intra-county commute is 14.3 miles; Inter-county commute is 26 miles; and through-county commute is more than 55 miles. The vast majority (98%) of all commuting is done with personal vehicles (of this 86% commute alone and 10% carpool). Only 2% opt for public transit. Loudoun County's economic development plan calls for an aggressive growth in employment in the County itself. By 2040 the population to job ratio is expected to be 1.5:1. The average commute will be 21 miles each way. This means a reduction of 4 miles or 16% for 80% of travel. Factored to the total journeys including non-commuting, the reduction is 13%.

Use of More Fuel Efficient Vehicles

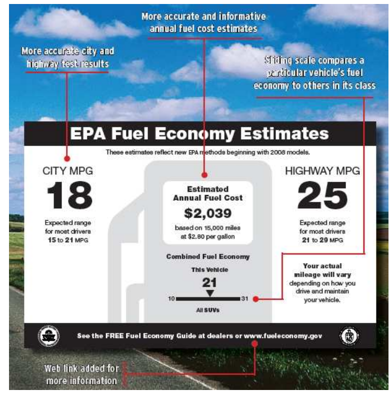
At a County level, achieving the lower emissions desired by 2040 will be an enormous challenge requiring significant change. Loudoun County can lead by example and policy by considering the following approaches encouraging the use of more fuel efficient vehicles:

- create a County-wide program to encourage the widespread use of efficient personal vehicles to gain fuel efficiency by 2% per year for the foreseeable future
- visibly contribute to the goal by using more fuel efficient vehicles for all publicly funded vehicles
- adjust parking privileges for different classes of vehicles
- team with local auto dealers to promote specific choices
- team with fuel providers to promote specific choices
- promote the US EPA Green Vehicles initiative (see Figure G.6)
- encourage awareness of fuel consumption by promoting US EPA Fuel Economy Estimates[131] (see Figure G.7)

[131] US EPA 2 pp, 649K, EPA420-F-07-065, December 2007

Figure G.6: US EPA Green Vehicles Guide[132]

Figure G.7: EPA Fuel Economy Estimates[133]



At the present, models suggest that progress in fuel efficiency improvements has been offset by increasing transportation demand and increase in vehicle size (mostly a result of SUV popularity). The current US CAFE fuel efficiency standard of 27.5 miles per gallon (mpg) for passenger cars produces at best an approximated average of 162 grams per mile (g/mi) or 260 grams per kilometer (g/km) of CO2 emissions. The US CAFE standard for light duty vehicles, including SUVs and light trucks, is lower at 21.5 mpg. Caution should be used when applying the CAFE standard as actual driving conditions yield even lower fuel efficiency standards. In fact, in 2007 US drivers reported significantly lower fuel rates: 22.5 mpg for passenger cars and 18 mpg for light duty vehicles[134].

[132] US EPA 2 pp, 385K, EPA420-F-07-063, November 2007
[133] US EPA 2 pp, 649K, EPA420-F-07-065, December 2007
[134] US Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, 2007.

Figure G.8: Actual and Projected GHG Emissions for New Passenger Vehicles by Country, 2002-2018[135]

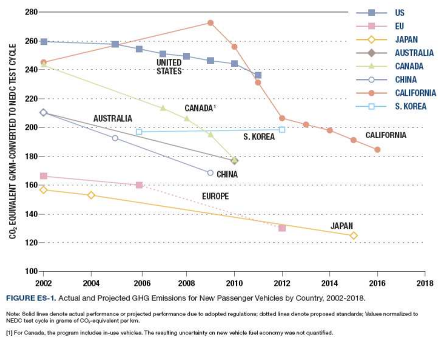


Figure G.9: Actual and Projected Fuel Economy for New Passenger Vehicles, 2002 - 2018[136]

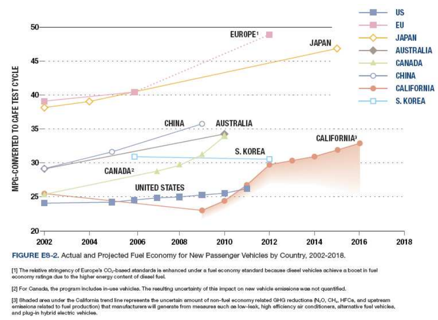


Figure G.10: EU Profile of New Vehicle Registrations: ACEA[137] **wave-effect of CO2 categories towards reduced CO2 emissions**

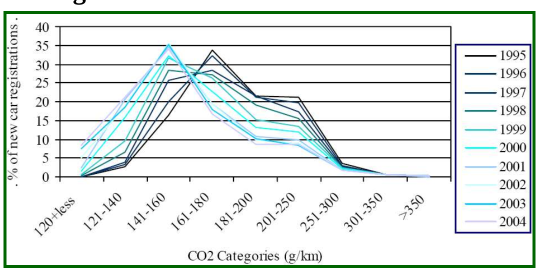
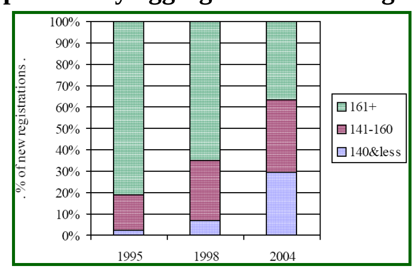


Figure G.11: EU Percentage of New Vehicle Registrations Change in ACEA's Fleet Composition by aggregated CO2 Categories[138]



Compared to the EU's current average fleet emissions of 150 g/km (see Figure G.8 above), the US lags behind. Even with the 2015 CAFE goal of 35 mpg there is a significant gap between the US 2002 EU standards (which in CAFE-converted mpg terms was about 38 mpg)[139]. The 2012 EU target for passenger cars is 120 g/km with a stretch goal of 95 g/km by 2020. The 2012 EU light-commercial vehicles (vans) target is 175 g/km (160 g/km by 2015). The EU profile and percentage of new registrations are illustrated above (see Figures G.8 to G.11).

VW Unveil 189mpg L1 Concept Car[140]

The Frankfurt Motor Show saw the unveiling of Volkswagen's L1 Concept car – a diesel-electric hybrid vehicle constructed from aluminum and carbon fiber. Weighing just 380 kg, the car is capable of a maximum speed of 99mph. Its fuel-economy figures suggest that when running at

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[135] p.8, Figure ES-1, The International Council on Clean Transportation (ICCT), *Passenger Vehicle Greenhouse Gas and Fuel Economy Standards: A Global Update*, July 2007.
[136] p.9, Figure ES-2, The International Council on Clean Transportation (ICCT), *Passenger Vehicle Greenhouse Gas and Fuel Economy Standards: A Global Update*, July 2007.
[137] ACEA = European Automobile Manufacturer's Association
[138] SEC(2006)1078
[139] P.1, *Comparison of Passenger Vehicle Fuel Economy and Greenhouse Gas Emission Standards around the World*, Pew Center on Global Climate Change, December 2004.
[140] Publication Date: 18/09/2009b WWW Link: http://www.volkswagen.com

optimal speed the car can achieve 189 mpg on the combined cycle while emitting just 39 g/km of CO2. The L1's body has been designed to maximize aerodynamics, but despite its light weight (124kg) the car gains a lot of strength due to its use of carbon fiber reinforced plastic. At 3,813 mm in length, the L1 Concept is comparable to the VW Fox, yet at just 1,143 mm in height it's as low as a Lamborghini Murcielago. Its width, at just 1,200 mm, is narrower than any conventional car on sale today.

Every element of the L1 Concept has been designed with the intention of maximum efficiency. At its heart is a tiny 800 cc two-cylinder common rail, direct injection TDI engine. In 'ECO' mode the engine develops 27 PS at 4,000 rpm, in 'Sport' mode this rises to 29 PS and 74 lbs ft of torque developed at 1,900 rpm.

The modest kerb weight of the L1 Concept linked to efficient aerodynamics mean that it is capable of accelerating to 62 mph from rest in 14.3 seconds before reaching a top speed of 99 mph. Despite having only a 10-liter fuel tank the L1 Concept's incredible efficiency means that it is capable of traveling 416 miles between stops.

The L1 Concept draws inspiration from the original 1-liter car, unveiled in April 2002 when Dr. Ferdinand Piëch, then Chairman of the Board of Management, drove the concept between Wolfsburg and Hamburg. At that time productionizing the carbon fiber reinforced plastic body was simply not viable. With modern production processes, large-scale manufacture of such structures is now possible.

Shift to No-emission Vehicles

Through a range of policies, the County can actively encourage the use of electric and plug-in hybrid vehicles, building on the experiences of other communities.

In California, "Better Place" is working to develop an electric vehicle infrastructure and system. EV drivers will have access to a network of charge spots, switch stations and systems to optimize their driving experience and minimize environmental impact and cost. As a rough estimate each electric car generates a quarter the GHG emissions of a conventional car.

Using electric buses is another transportation innovation underway experimentally in some cities such as Chattanooga, Tennessee[141]. Zero-emission buses have most of the capability of conventional ones with greatly reduced total emissions.

Evolution of Material Technology

Independent of changes in travel patterns or vehicle style choices, the trajectory of automotive design through the extended use of advanced composites and lighter metal structures will increase vehicle fuel efficiency over the next three design cycles (about 12 to 15 years) by 15%. This is an external assumption included in the CES results.

Evolution of Drive Train Changes

The market adoption of drive trains with the equivalent performance of (Euro 5/6) diesel, diesel-electric, petrol-electric hybrids and electric-only drive trains combined with more sophisticated

[141] Electric Bus Model – Chattanooga, Tennessee http://www.afdc.energy.gov/afdc/pdfs/chatt_cs.pdf

fuel management techniques will continue such that by 2024 this level of performance will apply to nearly 100% of all new light vehicles, and assuming a 7 year ownership cycle, apply to 100% of the operating fleet by 2031. This externally driven assumption will contribute an average further 15% reduction in emissions.

Changes in Vehicle Style Mix

Independent of any changes in travel patterns, the average weight of the fleet will reduce as consumers purchase more crossovers (station wagons), hatchbacks and smaller SUV's and a reducing percentage of full-size SUVs and light trucks. This will be driven as much by market shifts as by fuel prices, carbon-taxes, horse-power taxes, denser urban design, structured parking strategies, etc. This will contribute a further 5% overall reduction in emissions.

Encouraging "Active Transportation" Through the Impact of Walkable Neighborhoods

The development of walkable and biking-friendly neighborhoods with local retail, schools, clinics and similar services can reduce the number of non-commuting travel journeys using vehicles and substitute carbon free walking or cycling.

Smart Growth principles promote street networks that offer many choices of alternate walking and bicycle routes. This is illustrated in Figure G.12 which contrasts Old Town Alexandria with Dale City. The latter street network offers few or no alternative bicycle routes. Convenient bicycle parking facilities would stimulate bike usage and thus facilitate intermodal local transport.

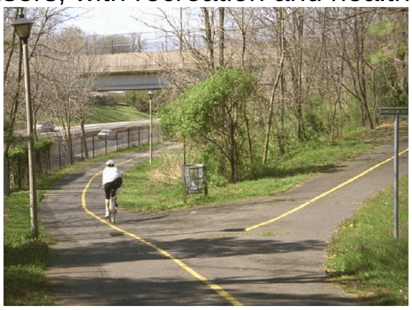
Figure G.12: Impact of Street Design[142]

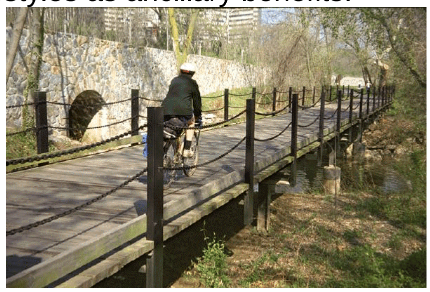
Old Town Alexandria   Dale City

The 2020 Plan promotes multi-use trails and comfortable walking environments connecting activity centers and creating a more extensive network. Improvements in the plan include the VA 7 bikeway (between Tyson's Corner and Loudoun County line), US 50 bicycle route throughout Northern Virginia, W & OD trail connection from Leesburg to Whites Ferry and the VA 234 trail.[143] The Northern Virginia Regional Bikeway and Trail Network[144] is planning a regional network that will include on-road bicycle facilities such as paved shoulders and bike

[142] p.10. VDOT, *Northern Virginia Regional Bikeway and Trail Network Study*, Final Report Nov. 19, 2003
[143] p.9 Northern Virginia 2020 Transportation Plan, Improvements for short, medium and long-term transportation needs http://virginiadot.org/projects/northernvirginia/northern_virginia_2020_transportation_plan.asp
[144] http://virginiadot.org/projects/northernvirginia/regional_bike_and_trail_network_study.asp

lanes, as well as off-road multi-use trails. It will serve the transportation needs of bicyclists and other trail users, with recreation and healthier lifestyles as ancillary benefits.





Riding trails in Northern Virginia[145]

Densification of Neighborhoods

Developing denser neighborhoods implicitly discourages the use of larger vehicles. This, combined with traffic calming measures, including sign free mixing of motorized vehicles and pedestrians encourages the use of small motorized vehicles including small displacement scooters, motorcycles, three-wheelers, Smart Cars and small EV's. This trend should be a consideration in the roadway design for these neighborhoods and links between neighborhoods.

Summary

Meeting the goals of journey avoidance and vehicle efficiency gains has an enormous impact on the energy footprint and greenhouse gas footprint of Loudoun County. The emissions in transportation will decrease from 5.77 mt CO_2e per capita in 2007 to 2.77 mt per capita by 2040. The primary energy use in 2040 will be reduced by 1,070 GWhe per year from 5,836 GWhe to 4766 GWhe, despite the substantial increase in overall travel. Clearly this is one of the most challenging targets, but is also one of the most attractive efficiency opportunities.

[145] VDOT, *Northern Virginia Regional Bikeway and Trail Network Study*, Final Report Nov. 19, 2003

Appendix H: Elements of Flexible Energy Supply

Importantly, with challenge comes opportunity and counties now have the opportunity to question the existing infrastructure and rethink the current energy supply paradigm. Rather than start with the currently available energy supply and its inherent inefficiencies, the more rational approach is to begin with defining the service need and then optimize the delivery and production process, making the most of efficiency and any fuel that is used (Figures H.1 and H.2 below). This was the basic framework applied to the development of the Loudoun County CES.

Figure H.1: Our Dysfunctional Energy Supply Chain[146]

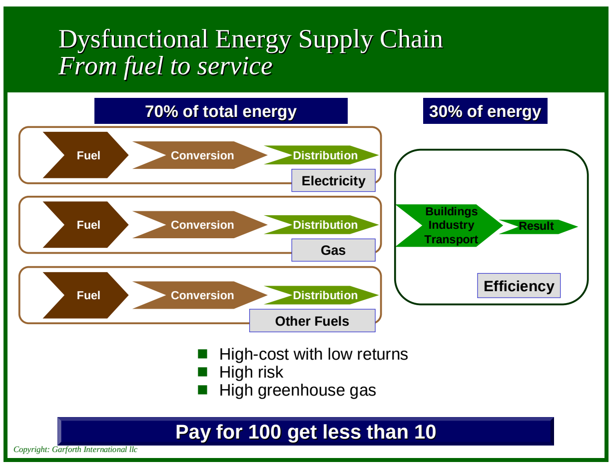
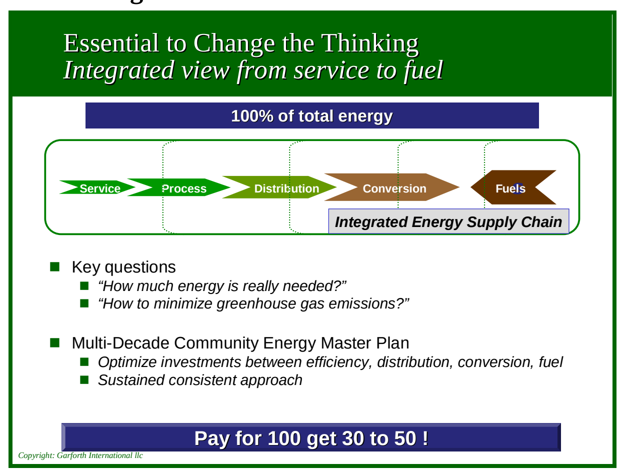


Figure H.2: Rethinking our Energy System with an Integrated View from Service to Fuel[147]



District Energy

The CES has recommended the implementation of district energy (heating and cooling) with energy from multiple sources, combined with higher levels of building efficiency in higher density neighborhoods.

The CES takes into account that options for fuel, energy conversion, and distribution and management technologies will change over decades, and that there must be sufficient flexibility built in to adapt as costs and technologies change.

Once reasonably widespread district energy networks are in place, various heat and electricity sources can be easily combined, and the mix can be adjusted over time for economic or environmental reasons.

The following strategies are should be considered:

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[146] Garforth International llc
[147] Garforth International llc

- Consider creating district energy systems in the majority of high and medium density areas of Loudoun County.
- Consider creating a district energy services company (DECo.) that has the County's franchise to deliver a portfolio of energy services including district heating and cooling.
- Consider focusing initially on developing local networks within selected Scale Projects earlier with the ultimate aim to interlink the local networks into a County-wide structure.

District energy is transported in networks using pressurized hot and chilled water. This approach is more efficient than individual boilers furnaces and chillers. Energy distribution is done via insulated pipes laid in the streets, along with the water, waste water, electricity, and communication utilities. These pipes typically have a fully functional lifespan in excess of 60 years.

Connection at the buildings or homes is via a simple heat exchanger that transfers heating and cooling to the building's cooling, heating and domestic hot water systems, obviating the need for a local chiller, boiler and a furnace.

Integrating Renewable Energy Sources

The climate and surroundings of Loudoun County have reasonable potential for the implementation of renewable energy. However, with the current relatively low costs of electricity and natural gas, these will need to be phased in selectively.

A challenge for renewable energy sources in the US is they are competing in markets where there is no carbon penalty for use of fossil fuels. Neither are there carbon avoidance benefits for avoiding carbon creation through the implementation of efficiency and the use of renewable fuels and heat recovery.

In the EU, the value of a ton of carbon has fluctuated between a low of about $5 to a high of around $35 since the opening of the European Trading Scheme in 2005. It is a judgment call as to what is likely to be the market impacts of greenhouse regulation, but the likelihood of these being in the $15 range over the coming decade is high. (See Appendix N for more information on GHG Emissions Reductions Trading).

Based on the findings of the assessment, it is believed that use of both solar photovoltaic and biomass heat could provide significant benefits within the CES framework.

- Biomass - Biomass is a viable alternative to heating as a part of district heating systems. Biomass can be concentrated on boilers with around 1 MW or more thermal energy (see Figure H.3). Biomass heating can be integrated into any of the recommended district heating areas.

  Under current market conditions it is less attractive economically than natural gas CHP and boiler alternatives. Biomass heating should probably be regarded as a future option unless low-cost long-term fuel contracts can be concluded.

  In Europe, where wood-based biomass is increasingly common as a scale fuel, the experience has demonstrated that its prices rapidly align with natural gas equivalents. The earlier long-term contracts are made, the more advantageous the potential returns.

  Smaller scale biomass heating is becoming both cleaner and cheaper, and given the Loudoun County's rural areas, could be considered even for larger low-density properties.

  Figure H.3: Typical Modern 1 MW (Thermal) Wood Boiler

  From a greenhouse gas emissions standpoint, biomass heating is generally viewed as a carbon-neutral fuel. Another aspect of the evaluation will be the impacts of future emissions markets and legislation.

- Biogas - Loudoun County has a rural environment and could consider the production of biogas for fuel as a future option. Recent technologies for fermentation can create methane out of vegetative agricultural waste and animal excrement for use in CHP engines. This opens multiple possibilities for use and usable raw material. In connection with a district heating network it can use the heat in a highly efficient manner. A biogas fueled system is generally regarded as carbon neutral.

  Figure H.4: Biogas fermentation in Neuhaus, Germany

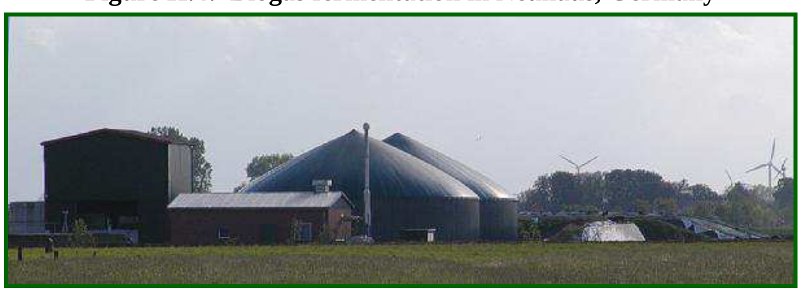
  

  Figure H.4 shows a typical plant with CHP engines in the foreground.

- Waste-to-Energy - Evaluate using municipal waste as an energy source for heat and electricity as a future option. One of the most neglected fuels in North America is municipal waste.

Figure H.5: Modern Municipal Waste-to-Energy Plant in South Carolina, US

Figure H.5 shows a modern waste-to-energy plant using French technology, in South Carolina. It uses about 200,000 tons of separated municipal waste as fuel a year, generating about 9 MW of electricity and slightly more equivalent useable heat in the form of both heat and steam. These systems meet global clean air standards, and generate much less greenhouse gas than landfill or composting.

Loudoun's rapid population growth suggests that it will continue to generate an increasing amount of waste. Clearly there must be a high focus on reduction and recycling. The balance can be a fuel with reasonably good thermal characteristics. Rather than disposing waste into landfills, waste could be used in a waste-to-energy plant(s). Recovered heat could be easily integrated into the district heating system.

The CES Team recognizes that this option will be the topic of a major community debate, and has not included any of the potential benefits in their assessment. However, the Team notes that there has been major technological progress since the early days of "waste incineration" and encourages the County to seriously consider this option in the light of today's technology.

- Geothermal Energy – With the implementation of a district heating strategy for a specific jurisdiction, the potential use of ground effect heat-pumps (low-temperature geothermal) will be limited. Water circulating through drilled pipes is the heat source for small heat pumps with heat recovery. Heat from solar collectors helps to regenerate the ground in summer. Also in existing buildings in the course of a deep renovation ground effect geothermal energy could be an option. Geothermal energy is not a likely option as a heat source for the district heating systems because of economics and low temperature level of ground effect geothermal energy.

- Renewable Transport Fuels - Public and individual vehicle users should constantly review available renewable fuel options, and where they make sense, procure and drive vehicles accordingly.

  Given the relatively small size of Loudoun County in relationship to the US, it is unrealistic to have a dedicated strategy for the County around renewable transport fuels. The County can put its influence behind state or national transport fuels initiatives.

Appendix I: Regulation, Management and Incentives

Regulatory Aspects

There is a basic paradox in most of the recommendations within the CES. They are all based on benchmarking information that clearly demonstrates the elements necessary to be integrated in terms of end use efficiency, energy distribution, and the choice and effective use of fuels. However, the benchmarking examples are operating in different regulatory regimes where the implementation of many of the measures has been either made mandatory or barriers to voluntary implementation have been removed.

For Loudoun County, the following basic regulatory constraints are noted along with suggested methods to manage them:

- Building codes are a state jurisdiction. However, the County can encourage better new building efficiency through voluntary programs, access to financial incentives, and the possibility of energy zoning for specific projects.
- Electricity generation, transmission, distribution, and pricing fall under state jurisdiction. The CES has made recommendations for significant amounts of electricity from cogeneration and renewable sources within the scale projects, which, if implemented, could be a part of the solution for electricity generation and distribution.
- Gas distribution is primarily owned by Washington Gas and is under state jurisdiction with competitive market options. The County does have the potential to use energy zoning for gas, heating and cooling distribution. The CES has recommended some applications for district heating and cooling within higher density projects, with potential for some expansion into adjacent areas.

  District heating can be a functional competitor with retail gas. However, experience from other jurisdictions, especially in Germany, Scandinavia and central Europe, is that competition between the two media is not economically sound. Therefore, putting in place voluntary or mandated energy zoning would be preferred.

  Since Dominion, NOVEC and Washington Gas are members of the CES team, and given the growing interest in Virginia in creating modern district energy systems, a resolution to these market and regulatory aspects should be possible. Gas will be a significant fuel source for any district heating system, in effect replacing many small potential retail gas customers with a few larger wholesale customers. If a district energy company is established as a public-private partnership it could be a potential investment interest for utility companies, in addition to becoming a major customer for natural gas.
- Vehicle efficiencies and transport fuel reduction policies are regulated at the Federal level. The CES has recommended voluntary measures and an urban design approach to these aspects which would encourage vehicle efficiency and transport fuel reductions.

Managing the Process: County Leadership

Civic leadership commitment is an essential element for the successful implementation of a successful energy productivity program. Loudoun County has already established the Committee on Energy & Environment, and has demonstrated to the community a commitment to energy efficiency through multiple school and county facility projects and the launch of the Green Business Challenge.

The County's role is crucial in successfully implementing the CES. They could use some of the following tools to help visualize their commitment to the CES process going forward:

- Making the Community Energy Strategy part of the public record, voted on by the Board of Supervisors.

  The Strategy should be revisited about once every five years for adjustments and course corrections on the recommendations. The basic Vision, Goals and Measurements (see Sections 4 and 7) should not be adjusted except to potentially make them even more aggressive in the future.

- Briefing all elected leaders, now and in the future, on the Vision, Goals and status of implementation of the CES.

  The importance of maintaining political neutrality in support of the basic framework of the CES cannot be overemphasized. Developing an efficient communal infrastructure that can deliver the kind of goals the County has embraced, will only happen with consistent long-term implementation.

- Briefing all non-elected leaders and department heads, now and in the future, on the Visions, Goals and status of the implementation of the CES, and the importance and role of their department in contributing to these goals.

- Confirming the visible commitment of the incumbent Chairman as the public "owner" of the Community Energy Strategy's Vision, Goals and results.

  This is analogous to the Team's experiences in industrial energy management. Companies where the CEO is visibly and continuously committed to energy productivity are the ones that deliver the breakthroughs. This is not a role that can be delegated.

- Making it a routine agenda item at all Board of Supervisor Meetings to check the progress of the CES.

  This would take just a few minutes' reporting on the progress against the CES Goals, significant actions taken, challenges, and corrective actions underway. It would show a clear commitment by the County to regularly report on the progress of the CES.

- Assigning a County Energy Manager as the single point of contact for the CES.

  A common argument against creating this role is that it may cause other departments to not fully take on their role and contribute to the success of the CES. Whoever takes on this role should have a high level of credibility in the community, and be clearly seen as having the full support of the Chairman.

Managing the Process: Community Engagement

The community in Loudoun County has shown extraordinary leadership to date in gathering together the key constituencies to develop the dialogue that has led to the CES. Moving into the implementation phase, the role of the CES Team members becomes even more important.

The following tools could be used to encourage community engagement:

- Upon accepting the Vision and Goals specified in the CES document, the County will be tasked with establishing recommendations on a strategy for moving forward. As the CES moves to implementation, new opportunities for additional community groups to participate will arise and original CES Team member's roles will shift.
- Actively creating neighborhood and community groups around the Scale Projects that are committed to ensuring there is a high level of local understanding and engagement in the broader goals. As the Scale Projects develop each will have their own constituency - some more business and industry focused, others in existing urban neighborhoods, yet others will be newcomers to the County's Greenfield environment.
- Utilizing the Colleges, Universities and high schools as the focus for educating all areas of the community in the multiple aspects of moving towards sustainable urban structures. This is a very broad area including formal curriculum offerings around energy and water resource planning and management, construction and facility management training, high school orientation, and public awareness. This could be the logical focus to consider for the clearing house for national and state incentives. This could include partnering with academic and civic leaders in either Germany or Scandinavia.
- Utilizing local schools as an outlet for educating the community in all aspects of the strategy and energy conservation initiatives arising from it. Elementary school students would be an ideal source for promoting energy conservation initiatives within their family environment and subsequently the community as a whole. All schools could take part in County-wide initiatives that could lead to measurable energy and GHG reductions at respective schools. High school curricula could include discussion on the CES and monitoring progress on initiatives arising from it.
- Following up on the conservation initiatives already established by the County to further engage local citizens and community groups to reduce energy use, save money, and reduce dependence on fossil fuels that create GHG emissions.[148] These initiatives could include:
  - reduce, reuse, recycle – minimize packaging and recycle household waste
  - use less heat and air conditioning by adding insulation, weather stripping, and caulking and adjusting the thermostat two degrees down for heating and up for cooling
  - replace light bulbs with CFLs
  - drive less and drive smart – take transit, walk, and bike
  - buy energy-efficient products and appliances

[148] Community example http://www.eastgwillimbury.ca/Environment/10_Ways_to_Reduce_Greenhouse_Gases.htm

- use less hot water
- turn off lights when not in the room and water when not using it (i.e. when brushing teeth)
- plant a tree
- have a home energy audit performed to identify waste and utilize rebate programs
- encourage others to conserve

Budgeting Initial CES Implementation

In order to achieve breakthrough levels of efficient energy use and associated avoidance of greenhouse gas emissions, the County supports the completion and implementation of a County Energy Strategy (CES). The CES is to be approved by the Board of Supervisors and will have a time horizon out to 2040. The important next step will be to establish financial support for the implementation phase in 2010.

Once the CES has been formally approved, it will be critical to immediately start the next phase in order to gain the greatest benefit of the recommendations. Budgets should be prepared accordingly. This next phase consists of policy and implementation related work that clarifies the background and practical details for various stakeholders. The following items are of particular importance in this phase:

Policy related work:

- energy zoning rules
- building criteria for small scale and larger scale developments
- energy performance labeling recommendations
- transportation guidelines

Implementation and outreach related work:

- creating CES At-a-Glance packages for citizens, builders, developers, industrial developers and end users
- establishing reporting processes
- creating urban design and building efficiency explanatory guidelines
- information packs on energy performance labeling
- CES information packs covering transportation
- information packs and workshops on district energy
- creating a baseline GHG for monetization
- evaluating the process to document and register GHG emission numbers

There are grant and other non-tax vehicles available to support these next steps. While some funding sources are available to municipalities, others are available to businesses, private home owners, individual citizens, and community groups.

Incentives Available for Energy Efficiency

Federal Income Tax Provisions

Both consumers and businesses can receive information they need to make use of the federal income tax benefits for energy efficient products and technologies. These can be for building performance, renewable energy and transportation. Contact the Virginia Department of Mines, Minerals, and Energy or visit the Tax Incentives Assistance Project website at www.energytaxincentives.org.

Business Grants, Loans and Financing Opportunities through Business.gov
Find lenders that provide loans to small businesses interested in making energy efficient upgrades. Learn about the wide-range financing options available, from small improvements to complete system upgrades. Discover special offers and rebates on office equipment, electronics, appliances, and lighting products in your local area. Visit http://www.business.gov/expand/green-business/energy-efficiency/get-started/financing.html.

Loudoun County Green Business Challenge
Loudoun County has launched the Green Business challenge, which will work with local businesses to increase their bottom line with energy and cost savings, reduce carbon emissions, and provide recognition for leadership in the community. For more information, contact the Green Business Awards Manager at GreenBusinessAwards2009@loudoun.gov.

Loudoun County Property Tax Exemption
Loudoun County offers a property tax exemption for residential, commercial or industrial properties having solar energy equipment, which under Virginia statute is defined as equipment "designed and used primarily for the purpose of providing for the collection and use of incident solar energy for water heating, space heating or cooling or other application which would otherwise require a conventional source of energy." For more information contact the Virginia Department of Mines, Minerals, and Energy.

Reduced Property Tax Assessment for Energy Efficient Buildings
Under Virginia legislation, cities and counties may assess the property tax on residential, commercial or industrial buildings at a reduced rate, if the building exceeds the Virginia Uniform Statewide Building Code by 30%. Alternatives can include qualification for the Green Globes Green Building Rating System, the Leadership in Energy and Environmental Design (LEED) System, the EarthCraft House Program or the EPA Energy Star home.

Net Metering
Virginia allows "net metering" of excess electricity generated from renewable energy systems. Net metering allows customers to receive the full retail value for their excess electricity at times when their system is producing more electricity than the building is consuming.

Virginia's current net-metering law covers residential systems up to 10 kW and commercial systems up to 500 kW. Enrollment is open on a first-come, first-served basis until the rated generating capacity owned and operated by customer-generators in the state reaches 0.1% of each electric distribution company's peak load for the previous year. For more information contact the Virginia Department of Mines, Minerals, and Energy or the Commonwealth of Virginia State Corporation Commission.

Clean Energy Financing
Virginia law authorizes localities that have adopted local ordinances creating a clean energy financing program to provide loans for the initial acquisition and installation of clean energy improvements by property owners. A property tax assessment would repay the loan amount. For more information contact the Virginia Department of Mines, Minerals, and Energy.

Sales Tax Holiday: Energy Star and WaterSense Qualified Products
During a specified period, purchases of certain Energy Star and WaterSense qualified products purchased for non-commercial use and costing $2,500 or less will be exempt from sales tax. The exempt Energy Star items include dishwashers, clothes washers, refrigerators, air conditioners, ceiling fans, compact fluorescent light bulbs, and programmable thermostats that carry the Energy Star designation. The exempt WaterSense items include bathroom sink faucets, faucet accessories, and toilets. The 2009 holiday took place Friday, October 9, 2009 through Monday, October 12, 2009.

Energy Leasing Program for State Agencies
The Commonwealth's Energy Leasing Program is a loan program to finance energy efficiency projects in state agencies. The Commonwealth has secured $40 million in financing for projects, which can include lighting and motor upgrades, building envelope improvements, and equipment or control enhancements. The loans are expected to be repaid by agencies from energy savings generated by the projects.

Virginia Energy Assistance Program (VEAP)
The Energy Assistance Program assists low-income households, particularly those with the lowest incomes that pay a high proportion of household income for home energy. It is comprised of four components:

- Fuel Assistance - Helps with the cost of heating
- Crisis Assistance - Helps when fuel assistance and other resources don't meet the need
- Cooling Assistance - Helps with cooling emergencies resulting from extreme heat
- Weatherization Assistance - Assists with energy efficiency and air infiltration

For more information, contact the Virginia Department of Social Services or the Virginia Department of Housing and Community Development.

Dominion Virginia Power CFL Discount Program
Dominion Virginia Power in cooperation with local retailers is offering reductions of $1.50 on each single bulb purchased, and $3.00 on multipacks (Limit 25 bulbs per customer).

Visit www.dom.com to find a participating store.

Load Management Program
Under a utility program, load management switches are installed in homes by qualified service technicians. During peak demand for electricity, the load management switch turns the water heater or air conditioner off for a period of time. The peak demand periods usually occur only a few days each month and last for a few hours. Contact the local utility provider for more information.

Energy Financing Districts

Local governments can consider establishing energy efficiency and renewable energy financing districts (EFD) as first proposed by the City of Berkeley, California in 2007. EFDs have received increasing attention as a mechanism for financing residential or commercial clean energy projects, including energy efficiency, solar photovoltaic, or solar thermal systems. EFDs enable local governments to raise money by issuing bonds to fund these clean energy projects. For local governments, an EFD provides an opportunity to address climate change locally, to support residents' environmentally friendly building improvements at low cost to the government, and to strengthen the local economy in energy efficiency retrofitting and solar installation. Because the loans are secured by property liens, an EFD program provides virtually no risk to the local government's general fund.

A guide for local governments on energy efficiency and renewable energy financing districts has been prepared by The City of Berkeley and the Renewable and Appropriate Energy Laboratory at the University of California, Berkeley. This report is designed for local government officials, local government decision makers, state policy makers, and civil society groups interested in establishing an Energy Financing District (EFD) program in their region. It provides case studies of the experience from trailblazing communities such as Berkeley and Palm Desert in California; Boulder County, Colorado; and Babylon, New York. The guide describes the process of setting up an EFD program, including administrative, legal, and financial issues.

For more information and to download the report, please visit
http://www.ci.berkeley.ca.us/ContentDisplay.aspx?id=44262

The guide may also be accessed at:
http://rael.berkeley.edu/files/berkeleysolar/HowTo.pdf.

Appendix J: GHG Emissions Reduction Trading

This section outlines steps for potentially creating a process to monetize tradable environmental and tradable energy benefits that will result from the Loudoun County Energy Strategy. The shape of future US legislation around climate change, will decide the attractiveness or otherwise of setting up a formal process to monetize GHG Emissions Reductions within Loudoun County. At the time of preparing the CES, Federal legislation was in debate in both Houses of the US Congress.

Summary

The implementation of a County-wide multi-year integrated energy strategy can result in an annuity-like flow of tradable energy and environmental benefits. These benefits might include sales of energy, both renewable and conventional, tradable emission reductions, emission reduction credits, energy efficiency credits, renewable energy credits, and tradable tax credits.

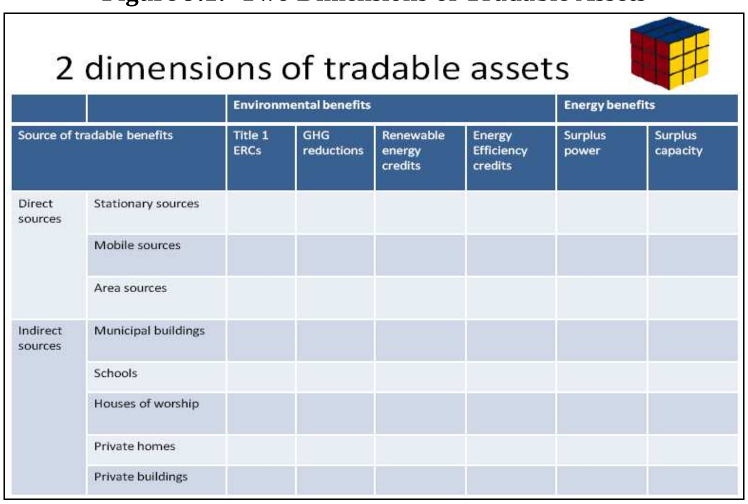
Greenhouse gases (GHG) mitigation draws intense media attention. But from a practical perspective numerous other tradable energy and environmental assets arise from good, long-term, energy planning. These off-book assets should not be ignored.

The subjects of this summary are the characterization of opportunities to capture financial value by creating and using tradable assimilative capacity and by creating and trading other energy environmental assets.

The Model

The range of potential opportunities may be described by a three-dimensional matrix. Two dimensions of this matrix are presented in Figure J.1.

Figure J.1: Two Dimensions of Tradable Assets



2 dimensions of tradable assets

		Environmental benefits				Energy benefits	
Source of tradable benefits		Title 1 ERCs	GHG reductions	Renewable energy credits	Energy Efficiency credits	Surplus power	Surplus capacity
Direct sources	Stationary sources						
	Mobile sources						
	Area sources						
Indirect sources	Municipal buildings						
	Schools						
	Houses of worship						
	Private homes						
	Private buildings						

These two dimensions are: (1) sources of potential tradable assets characterized by direct or indirectness and (2) the type of tradable asset – environmental or energy. The third dimension, not shown, is whether or not the tradable asset arises by (1) virtue of a clear property-right based legal system such as exists for Clean Air Act (CAA) Title 1 emission reduction credits or CAA Title 4 SOx allowances or (2) does the asset arise through unregulated commercial interaction, which is the way voluntary GHG reductions are currently traded. The opportunities described below could fit within this mental cube.

Conclusions

1. ***County-wide Energy Strategies (CESs) can create several types of energy and environmental benefits that can be monetized and traded. These include:***

    - Emission credits – tradable energy credits that are derived from doing better than required under regulatory programs;
    - RECs/energy efficiency-like certificates – renewable energy certificates (RECs) and white certificates (energy efficiency related certificates, sometimes called "white certificates") are endorsed within the current draft of the Waxman-Markey bill. Specifically**,** the bill would create a renewable electricity standard (RES) that would require large utilities in each state to produce an increasing minimum percentage of their electricity from renewable sources. Qualifying renewable sources are wind, solar, geothermal, biomass, marine and hydrokinetic energy, biogas and biofuels derived exclusively from eligible biomass, landfill gas, wastewater-treatment gas, coal-mine methane, hydropower projects built after 1992, and some waste-to-energy projects. The renewable electricity standard:
        - Requires 6% of electricity to come from renewable sources by 2012
        - Requires 20% of electricity to come from renewable sources by 2020
        - Up to 5% can actually come from efficiency improvements
        - If a state determines that its utilities cannot meet the target, the efficiency component can be increased to 8% and the renewable component decreased to 12%
    - Tradable tax benefits
    - Voluntary GHG emission reductions (VERs) – emission reductions that meet certain criteria established by the issuing entity (e.g. the Gold Standard). These VERs vary in perceived quality and thus sell for a range of prices
    - Prospective GHG credits that might arise from future actions and are captured under a future nationwide or Virginia-wide GHG mitigation law

2. ***Many tradable benefits are "off-book energy assets"***

    Off-book assets are assets that are not listed on the financial books of a country, state, county, municipality or legal entity. Assimilative capacity is an off-book asset. Furthermore, while prospective environmental or energy savings do not appear on the financial books, these assets might be substantial and fiscal prudency dictates that they should be identified, tracked, and monetized.

    Consider a gross example to make the point. Countries like Russia and Ukraine have vast, untapped, energy resources that exist because of years' of poor planning, cross-subsidies, poor operation and maintenance, and illogical tariff structures. As a result, it is cheaper and faster to reduce the demand for energy though integrated energy efficiency planning (also referred to as creating "negawatts") than to create a new source of power generation (creating megawatts). While Loudoun County is far away from Russia and Ukraine in every sense, going forward, there are opportunities to put Loudoun County on an energy utilization trajectory that reduces the County's carbon footprint, enhances reliability, promotes sustainability, and finances some of the environmental infrastructure, in part, on the back of tradable emission credits, renewable energy credits, and energy efficiency credits, thereby converting an off-book asset to money.

By doing better than building energy code, by extracting hidden inefficiencies, and by pre-selling tradable energy and environmental assets, Loudoun County might be able to reduce up-front and continuing financial charges.

Lastly, it is no secret that the current Presidential Administration through the Department of Energy and other departments and agencies actively supports, via grants, credit enhancements, matching funds and other financial inducements, more and better energy efficiency and renewable energy programs. These benefits should be captured as soon as possible while sustainable-energy subsidies exist.

The County Energy Strategy is the roadmap that will describe both the energy path forward and opportunities for extracting value from doing better than business-as-usual.

3. *Green energy and trading opportunities might emerge via a CES*

Loudoun County does not have many large direct emitters of criteria pollutants such as NOx, SOx, or particulate matter or greenhouse gases. Nevertheless, energy and water demand will increase over time as exurbs expand into suburbs and suburbs become urbanized. In addition, emission sinks and assimilative capacity of forest, agriculture, wetlands, etc. also are factors in establishing and maintaining sustainability and protecting traditional environmental life-style of County denizens.

- Stationary sources: opportunities to create extra efficiencies result from increased use of cogeneration and tri-generation (simultaneous local generation heating, cooling, and electricity) community-level energy utilization, increased use of local recyclable energy products such as bio-fuel, organic waste, sludge, and other recyclable energy sources.
- Mobile sources: greater utilization of public-sector and private-sector fleet management programs, fuel conversions, and the aggregation of demand to lower purchasing, operations and maintenance costs.
- Indirect sources: greater use of solar, geothermal, small scale wind, insulation, windows, controls and sharing of heat, cooling, and power loads

4. *Consideration of sustainability within a County Energy Strategy is neither innovative nor costly but must be wisely pursued*

As the first rule of medicine is: "do no harm"; so is one of the first rules of managing municipal finances to "contain costs." If implemented wisely, integrated energy plans will yield cost savings. But the execution of the plan requires public sector commitment, leveraging the interests of the private sector and reducing transaction costs. It may be that there are many measures that can be taken by Loudoun County that require bundling with other counties or municipalities to reduce the burden of relatively fixed transactions costs, while in other cases, Loudoun County can fast-track energy efficiency improvements on a stand-alone basis.

The fixed costs to create and document tradable environmental benefits might be a barrier for monetizing some opportunities, and this fixed-cost barrier must be acknowledged from the outset. For example, to develop the required documentation for a GHG-credit mitigation project under Kyoto Protocol rules can cost at least $50,000 and as much as $200,000. Assuming the average selling price of Kyoto-GHG credits is $15/ton C.O.D, and that it takes at least 2 years from conceptualization to the creation of GHG credits, and considering that it costs $100,000 upfront for the documentation of the potential credits and the cost of risk-capital is 10%; then, without a risk adjustment, the project must return at least 8,000 tons of GHG credits to pay just for the documentation costs. A risk-adjustment, assuming that only 50% of proposed projects ever get fully financed and implemented means that any proposed GHG-credit project must produce at least 16,000 tons of GHG credits just to pay back documentation costs alone. To give this a scale – this would represent the effect of significantly retrofitting of 5,000 Loudoun homes.

While the numbers in the example above are realistic, Loudoun County will not be involved this year or next in any Kyoto-like transactions, if ever. Nevertheless, the point made is valid; investments in environmental credits must be viewed through a strict accounting lens. Thus, aggregation of tradable opportunities, in some cases makes sense, to lower transactions' costs and adjust risks for potential investors.

Considerations

These items should be considered when creating a process to monetize tradable environmental and tradable energy benefits that will result from the CES. They are based on advising other large institutions, designing and operating environmental benefits managing systems for the United Nations, large corporations, and other private-sector entities, and account for the rapidly changing environmental and energy regulatory landscape in the United States.

1. Creating systems that will continuously identify and track sustainability projects

People cannot manage that which is not measured in quality or quantity. Developing a system that tracks potential energy and environmental trading opportunities is imperative. Such a system should track potential projects from conceptualization through rejection or implementation. Data should enter the tracking system from various sources including from those organizations highlighted in Figure J.2 below. Users of the system include County leaders and staff, commercializers, the public and consultants to energy and environmental planners. It is worth noting that as project details become more and more refined, the project tracking system will better and better serve commercializers.

Figure J.2: Users, Beneficiaries, and Data Suppliers for Potential-Project Tracking System

	Loudoun County team members			Users	Data suppliers
	Information technology services	Energy planners	Environmental planners	Commercializers	Service providers
Early estimates of benefits					GIL/OC team
Prefeasibility study					GIL/OC team
Feasibility study					
Detail project engineering					
Construction and permitting					
Operation					

Figure J.2 illustrates a structure for such a system. A "Potential-Project Tracking" system should be created that points to, or captures in detail, those monetizable opportunities that arise today and will arise over time. Through the identification and tracking of opportunities through their life-cycle, energy and environmental leaders will be best prepared to market and commercialize these opportunities.

2. Considering non-traditional ways to extract value from off-book environmental and off-book energy assets.

These commercialization routes include, but are not limited to:

- Outsourcing the management of these potential resources to a private-sector entity with their compensation being, in part or whole, a carried interest in projects;
- Outsourcing the development and implementation of detailed project-specific plans that would be financed on the back of environmental and energy savings;
- Creating bonds that could be collateralized by the potential environmental and energy savings or sales; and
- Becoming part of a syndicate of counties that would collateralize bonds on the back of potential environmental and energy savings or sales, thus reducing transaction costs in the creation of a bond or other financing instrument:
  - Form such a coalition
  - Work with a private sector entity to form such a coalition,
  - Work with NGOs to form such a coalition, or
  - Work with DOE to form such a coalition.

The unit of action for commercializing measures could include:

- A building – prone to modest numbers of tradable assets and high transactions costs
- A collection of adjacent buildings – allows the capture of some economies of scale
- A campus or a town – a still larger unit of aggregation
- The County – the preferred unit of aggregation
- A collection of counties that have congruent or at least consistent objectives – a still more desirable unit of aggregation

3. Forming an Energy & Environmental Trading Advisory Team

Developing and implementing an Energy & Environmental Trading Advisory Team comprised of employees and advisors will allow the County to work with others (consultants, partners, NGOs, or county stakeholders) to pursue activities that have a high probability of creating tradable GHG credits.

This team should periodically meet to assess opportunities to create tradable GHG reductions and to work with interested County, regional and other experts to assess the benefits to be derived from creating these credits. In addition, this team would take steps, as dictated by events, to create, certify, store, and trade environmental and energy assets.

4. Developing a priority list of tradable GHG emission reductions and other tradable assets

Either the US will develop GHG emission management laws, in which case voluntary emission reductions (VERs) will be of lesser interest to potential buyers, or the US will not, in which case VERs will increase in use and value. In either case, preparing to develop projects that capture potential VER and actual GHG credit opportunities is a logical step to take.

Figure J.3: (DUMMY) Loudoun County Tradable Energy and Environmental Asset Evaluation Criteria

	Text or numeric data
Loudoun County controlled facility? Yes/No	
Capital cost of potential project	
Ongoing O&M cost	
Project payback period	
Assumed discount rate	
NPV	
IRR	
Transactions cost	
Partners? Describe?	
Does the investment have quantitative risks? If so, what risks? How are they measured? How are they mitigated?	
Are there risk management instruments?	
Can we unwind our position in case of a problem? How quickly?	
Who are the counterparties? Do we have data on the counterparties?	
Who are other stakeholders and describe their influence on the commercial outcome?	
What financing instrument(s) exist?	

The size and details of potential opportunities is the subject of an ongoing GIL/Owens Corning study. Assuming that commercializable outcomes derive from the study, a priority list of relatively near-term opportunities could be developed and compared against energy, environmental policy, and commercial evaluation criteria. This same process could be undertaken for other tradable energy and environmental assets but can initiated only after initial CES studies have been completed.

Since regulatory and economic data constantly change, such a prioritization system should connect to the tracking systems described above.

Potential evaluation criteria might include those listed in Figure J.3 above. This evaluation tool could be used as a beginning point for developing an evaluation tool specific to the County that would be used to screen opportunities with, or without potential partners.

Appendix K: Loudoun County Tracking System for Energy and Environmental Projects

This Appendix is included to give an indication of the kind of project tracking and information management systems that would be appropriate to ensure energy, efficiency and greenhouse reductions and other environmental credits could be monetized. It is not meant as a firm proposal of the current CES. As has been clarified in other communications around the CES, monetization of emissions credits would be in response to possible national legislation, and not a local imitative. The illustrations in the following pages are from a prototype MIS developed by John Palmisano and Gregory Lvovsky to promote better project tracking for the various US Government and International Organizations, and large corporations.

It is feasible to consider outsourcing these kinds of environmental auditing and trading functions, but again no decision is called for until the shape of future US legislation becomes clear.

Background

A suitable tracking system for potential energy and environmental projects and GHG credits would connect several Loudoun County specific databases:

- Energy and environmental plans,
- Existing and proposed environmental and energy regulations,
- Evaluation criteria for selecting projects,
- Economics data, including oil, gas, power, capacity, ERC, GHG credit, and other relevant exogenous energy and environmental data, and
- Technology data bases.

Such a system could tie into existing and contemplated energy and environmental planning systems for Loudoun County. Such a MIS can be a unifying tool to give focus to project identification, tracking and creation. Figure K.1 illustrates a sample tool to manage energy and environmental trading opportunities for Loudoun County.

Figure K.1: Sample MIS Tracking System – Trading Opportunities

Please enter basic information and assumptions regarding the business enterprise

Years of Analysis	8		User **must** enter a value in this cell
Fund Manager		12,345	Text or numerical value entered by user
Total Management Costs	2.50%	12,345	Unacceptable numerical value entered by user or result thereof
Incentive Fees	20.00%	12,345	Value calculated by the program
Due Year for Incentive Fees	7	2007	Variable to be changed by user during decision-making

Investors	2006	2007	2008	2009	2010	2011	2012	2013	2014
Annual Contributions	$ 50,000,000	$ 50,000,000	$ 50,000,000						
Reinvestment Ratio	50.00%								
Target Rate of Return	20.00%								

General Assumptions	
Discount Rate	10.00%
Overall Revenue Loss Factor	3.00%

Account for ERC trading ☑ Allow ERC acquisition from third parties (incl. futures) ☑ ERC spot-sale success rate 75.00%

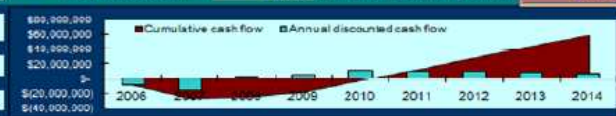
Include:	Spot prices in:	2006	2007	2008	2009	2010	2011	2012	2013	2014
GHG ☑	$/t			13.5	11.6	9	8	9	9	
NOx ☑	$/t	5	5	5	5	5	5	5	5	5
SOx ☑	$/t	4	4	4	4	4	4	4	4	4
VOC ☑	$/t	3	3	3	3	3	3	3	3	3
Particulates ☑	$/t	2	2	2	2	2	2	2	2	2
Other (see below) ☑	$/t	1	1	1	1	1	1	1	1	1
Enter description here										

Assume SFT for GHG ☑ Use general assumptions instead of specific sales ☑ SFT price tied to spot ☐

SFT forward price in 2006	$/t				10	9	8	8	7	

Share of ERC to sell as SFTs 80.00% Sales success rate 90.00% Standard insurance premium 25.00%

Results of the Analysis	
Enterprise IRR	28.24%
Enterprise NPV	$ 25,777,549



Countries (enter at > prompt)
- Ukraine
- Russia
- Moldova
- Bulgaria

Figure K.2 illustrates a sample tool to track a portfolio of Loudoun County projects.

Figure K.2: Sample MIS Tracking System – Project Portfolio

Enterprise Cash Flow Statement and Analysis

	2006	2010	2011	2012	2013	2014
Cash Flows From (Used by) Operating Activity						
Income (Loss) from Operating Activity	$ -	$ 17,000,001	$ 17,000,001	$ 17,000,001	$ 16,800,007	$ 16,813,013
Sales of GHG reduction credits	$ -	$ 2,124,360	$ 1,897,750	$ 2,136,110	$ 2,149,913	$ -
Acquisitions of GHG credit from third parties	$ (10,000,000)	$ (1,425,000)	$ (1,425,000)	$ (1,425,000)	$ (1,425,000)	$ -
Sales of NOx reduction credits	$ -	$ 1,500	$ 2,050	$ 6,050	$ 9,550	$ 15,050
Sales of SOx reduction credits	$ -	$ 252	$ 496	$ 1,740	$ 3,184	$ 5,234
Sales of VOC reduction credits	$ -	$ 502	$ 369	$ 402	$ 465	$ 555
Sales of credits for particulates reductions	$	$ -	$ -	$ 20	$ 80	$ 140
Sales of other benefits	$	$ -	$ -	$ 10	$ 40	$ 71
Cash Flow from SFT deals	$ 1,000,000	$ 281,800	$ 272,500	$ 272,500	$ 272,500	$ -
Management Costs a 2.50% of invested funds	$ -	$ (1,204,525)	$ (1,242,025)	$ (1,242,037)	$ (1,242,038)	$ (1,242,038)
Loss at 3.00% of total revenues	$	$ (510,000)	$ (510,000)	$ (510,000)	$ (504,000)	$ (504,390)
Incentive Fee at 20.00% of excess returns	$ -	$ -	$ -	$ -	$ -	$ -
Net Cash From (Used by) Fund Activity	$ (9,000,000)	$ 16,268,890	$ 15,996,141	$ 16,239,796	$ 16,064,701	$ 15,087,635
Cash Flows from (Used by) Capital Investment	$ -	$ -	$ (1,500,000)	$ (500)	$ (10)	$ (20)
Cash Flows From Financing	$ 50,000,000	$ -	$ -	$ -	$ -	$ -
Increase (Decrease) in Cash	$ 41,000,000	$ 16,268,890	$ 14,496,141	$ 16,239,296	$ 16,064,691	$ 15,087,615
Cash, Beginning of the Year	$ -	$ 131,570,534	$ 147,839,424	$ 162,335,565	$ 178,574,861	$ 194,639,552
Cash, End of the Year	**$ 41,000,000**	**$ 147,839,424**	**$ 162,335,565**	**$ 178,574,861**	**$ 194,639,552**	**$ 209,727,167**
Net Free Cash Flow	$ (9,000,000)	$ 16,268,890	$ 14,496,141	$ 16,239,296	$ 16,064,691	$ 15,087,615
Discounted Cash Flow	$ (9,000,000)	$ 11,111,871	$ 9,000,963	$ 9,166,659	$ 8,243,727	$ 7,038,484
Cumulative Cash Flow	$ (9,000,000)	$ (2,160,576)	$ 12,335,565	$ 28,574,861	$ 44,639,552	$ 59,727,167

IRR	28.24%
NPV at 10%	$ 25,777,549

Figure K.3 illustrates a sample tool to track prospective projects that would help Loudoun County planners, project developers, and stakeholders.

Figure K.3: Sample MIS Tracking System – Potential Energy and Environmental Trades

Total Investors Funds	$	250,000,000
Total Capital Investments	$	30,482,000
Years of Operation		2004 - 2012
Target Rate of Return		10.0%
Fund IRR		10.2%
Minimum Cash at the End of the Year	$	50,000,000

GHG Reductions (CO2 eq. t)	907,590
NOx Reductions (t)	192,100
SOx Reductions (t)	166,539
VOC Reductions (t)	1,254
Particulate Reductions (t)	803
Other Environmental Benefits	

Sort Projects by: F — in ascending order Λ

ID#	Project title	Description	Type	Simple Payback (Years)	Capital Cost	Annual savings (Revenue)	Construction Period (Years)	Year to Start	GHG Reductions (CO2 eq, t)	NOx Reductions (t)	SOX Reductions	VOC Reductions	Particulates Reductions
Bel1	Baranovichy Plant of Automatic Transfer Line	Reconstr	CHP	4.2	$ 983,000	$ 235,480	1	2007	3200	1200	106	10	1
Bel 2	Reconstruction of boiler-house "Kedyshko" a	Reconstr	CHP	3.5	$ 2,600,000	$ 743,510	1	2006	25000	38	11	10	2
Bel 3	Reconstruction of street lighting in DZ "Kedy	Reconstr	Lighting	3.7	$ 302,000	$ 81,450	1	2006	1900	700	70	10	5
Bel4	Reconstruction of Heat Units and Control Ho	Reconstr	CHP	2.2	$ 690,000	$ 267,000	1	2006	2400	870	260	20	1
Bel6	Vitebsk demonstration zone Heat Supply by	Vitebsk	CHP	3.7	$ 4,375,000	$ 1,190,000	1	2006	12500	4500	5	1	1
Ru 2	Moscow Medical Academy Retrofit of Heat S	Moscow	Energy efficiency activities	2.0	$ 405,000	$ 198,500	1	2006	20000	7700	790	50	5
Ru3	Moscow Hospital No.4 Modernisation of the	Moscow	Energy efficiency activities	2.9	$ 410,000	$ 142,000	1	2007	4200	1500	160	10	10
Ru4	Moscow Hospital №1 Modernisation of Heat	Moscow	Energy efficiency activities	1.3	$ 113,000	$ 86,000	1	2005	8900	3200	330	10	10
Ru5	Semashko Regional Hospital Energy saving	Semashi	Energy efficiency	3.9	$ 765,000	$ 194,000	1	2007	9200	440	160	5	1
Ru6	Klimovo village boiler station reconstruction.	Klimovo	CHP	2.5	$ 548,000	$ 221,000	1	2008	5600	8200	48000	1	1
Ru8	Russian State Medical University Adjustmer	Russian	Energy efficiency activities	0.9	$ 85,000	$ 100,000	1	2005	11000	4000	400	25	1
Ru17	Lenteplasnab JSC. St Petersburg. Leningrac	Lentepla	CHP	3.2	$ 8,000,000	$ 2,500,000	3	2005	25000	8000	800	50	10
Ua1	Implementation of energy saving solutions in	Impleme	Energy efficiency activities	3.4	$ 342,000	$ 102,000	1	2005	665	150	250	10	10
Ua2	Installation of automated temperature contro	Installati	Energy efficiency activities	3.5	$ 283,000	$ 81,000	2	2006	1400	500	320	10	10
Ua4	Setting up a unit for heat carrier preparation	Setting u	CHP	3.3	$ 624,000	$ 190,000	1	2006	4500	250	250	10	1
Ua5	Upgrades to the lighting and heat supply sys	Upgrade	Energy efficiency activities	3.6	$ 145,000	$ 40,000	1	2006	580	50	59	2	1
Bg1	Generation of thermal energy/ Heating syste	Improven	Energy efficiency activities	7.1	$ 825,000	$ 117,000	1	2005	600	60	60	1	1
Bg6	Bourgas Replacement of the old lighting illu	Replacer	Lighting	3.4	$ 3,500,000	$ 1,020,000	3	2005	18000	500	250	10	50
Bg16	Heat transfer pipelines reconstruction of Per	Heat trar	CHP	4.0	$ 3,305,000	$ 820,000	5	2005	18000	500	250	10	100
Bg21	Increasing the energy efficiency of the Sofia	Increasir	Energy efficiency activities	0.8	$ 2,282,000	$ 2,790,000	1	2005	25000	500	250	10	10

The prototype GHG MIS suggested above could be the basis for a Loudoun County GHG MIS. To start, the GHG MIS could initially be a platform for a subset of energy and GHG project data or Loudoun County users could seek a fully developed existing GHG MIS to customize, or Loudoun County could develop their own MIS from the ground-up. The choice is not simple.

There are a variety of so-called off-the-shelf systems that could be a basis for a Loudoun County GHG MIS and there are systems that could be built-upon to create a customized application.

There are systems that claim to manage or integrate all GHG emissions data and processes into a unified system. This integration requires multiple components of computer software and hardware and uses a unified database to store data for all system modules. The result is a powerful energy and environmental management tool.

A Loudoun County energy and environmental MIS might assist managing the entire lifecycle of energy and GHG reduction projects from "cradle to grave" by managing all data related to the identification, creation, quantification, serialization, reporting, tracking and marketing of credits. It could provide support for managing all of the inputs such as the properties, operational practices, historical use information, property owners, service agreements and contracts for any selected credit-creation protocol, the protocol coefficients, document creation, document management, the sales cycle and all of the necessary financial information.

The core elements of this enterprise solution could include:

- Supply chain management,
- Credit creation factors such as serialization and inventory management,

- Financial statements and other financial and operational reports,
- Customer relationship and contract management,
- Data warehousing and data/credit audit trail,
- Universal compliancy,
- Business Intelligent Reporting including multi dimensional analysis, and
- Project financial accounting.

The front end of the MIS could include:

- Quantification of offsets based on selected protocols,
- Credit creation, serialization and inventory management,
- Contact management,
- Document management,
- Multi project management, and
- Contract management

The system could be on either a stand-alone or internet platform. Alternatively, small stand alone modules could be developed and built upon as needs change.

Importantly, audit ability must be built-in and not just added-on when needed later. Audit tables that record the historical proposed and actual GHG transactions should be in place from day-one. This means that, should the need arise it is possible to retrieve a complete history of all data transactions to support legal and regulatory challenges.

Data Management Life Cycle

A large amount of data could be required to support a County-wide GHG MIS. In addition to managing this data, its security and integrity, a GHG MIS must implement and enable business processes so that end users can work efficiently, confident that the application will respond in a timely and meaningful manner as they interact with it.

The operational goals of such a system could include:

1. Ease of data entry,
2. Ease of data retrieval,
3. Elimination of data entry errors (data checks, drop down lists, etc.),
4. Generation of meaningful reports, and
5. Capture of the right data.

The system should allow users to track significant entities such as:

- Contacts
  - People
  - Groups
  - Organizations
  - Sales Agents
- Properties
  - Historical operational use
  - Legal descriptions
  - Land Title Records

    - Owners
    - Renters
- Service Agreements
- Contracts
- Reductions/Credits
- Credit creation protocols
- Documents

A system might also enable the following business processes:

- Contact management
    - Manage suppliers
    - Manage customers
    - Manage sales agents
    - Manage auditors
    - Manage government contacts
- Land management
    - Land Title searches and integration
    - Validate owner details
    - Validate legal description and other data
    - Property owners and renters
    - Capture, update and validate land use data year over year
    - Capture, update and validate farming practices year over year
- Creation of service agreements and related documents
    - Associated land units with service agreements
- Create contracts
    - Generate legal documents
    - Projected credits & other summary data
- Manage chart of GHG credit creation protocols
- Manage credit creation and serialization
- Inventory management
- Back office integration

Once all relevant data has been captured and ownership of GHG credits has been validated, sales or use of GHG credit contracts are created. These contracts consist of a digital contract record.

Contracts are delivered to project owners (specific buildings or entities controlled or influenced by Loudoun County actions) who review all operational data. Once they have reviewed this data the contract may be signed and returned along with any other data that supports the energy saving/GHG reducing project.

Signed contracts would be reviewed by senior internal staff. When a contract is determined to be complete and correct it is approved by the reviewer. This event triggers a business process application that could lock down all of the data related to the approved GHG sales contract. This prevents this data from being deleted from the database and from being changed. Clearly, there is a need for protocols to grant access to read, edit, or write data from the GHG MIS.

GHG offset credits are then generated by system based upon the approved protocols. The charts of protocols contain the information required to determine the number of GHG offset credits generated by each activity in a contract. This would also apply to any and all data entered to track an organization's GHG footprint.

It may be that a third party auditor is required to verifying the energy savings and GHG reduction data and the protocols used to determine the offset credits. This verification process and the audit trail produced by the GHG MIS should adhere to relevant standards. Upon successful completion of the third party audit an application is made to the appropriate regulatory body for their stamp of approval on the offset credits generated.

It is imagined that Loudoun County managers might have varying reporting interests. Such reports might include:

- Accounting,
- Budgeting,
- Costing,
- Complete Reporting, exporting and integration into other data analysis and modeling tools, and
- Multiple financial books for various projects

For best results, these report modules should be built-in early on in the MIS development process.

Appendix L: 2007 CES Baseline

Energy and Emissions Assumptions

1.0 General Assumptions

By definition, the County Energy Strategy (CES) baseline includes all of the energy consumed by all parties within the geographic boundaries of the County.

Figure L.1: Loudoun, Fairfax and Prince William Counties[149]

1.1 Dulles Airport Excluded from CES

The Dulles Airport presented an immediate challenge for the CES. For practical reasons, the Team decided to exclude the Dulles Airport from the scope of the County Energy Strategy. As a Federal entity, the Airport straddles both Loudoun and Fairfax counties (see Figure O.1) and has its own focus on energy consumption within their facility.

The following statement was shared with the CES Team by Leo Shafer, President of the Washington Airports Task Force, charged to develop an energy and climate concept for Dulles.

"While Washington Dulles International Airport is Loudoun County's largest employer, aviation has been placed outside the scope of work for this energy plan. However, housing, related

[149] http://www.northernva.com/map.html

companies and services for the airport employees and interests within Loudoun County are covered by the plan.

The Metropolitan Washington Airports Authority already has a vigorous energy reduction campaign under way as part of civil aviation's worldwide goal of being carbon neutral by 2050 and of expanding henceforth without increasing their carbon footprint. Aviation's motivation is driven by economics as well as a concern for the environment, as fuel represents approximately 40% of an airline's operating cost.

The Metropolitan Washington Airports Authority has land and a customer base. The agency's strategy is to seek partners who can profit by using this land and customer base to reduce the airport's energy consumption and to progressively meet the airport's energy need from on-site generation.

The Airports Authority issued Requests for Information concerning photovoltaic power generation and electric vehicle charging infrastructure in June, as the first of approximately 20 energy initiatives."

Subsequently, the CES team has been advised that the GHG baseline for the airport is being established. It is suggested that at the appropriate moment, the CES be aligned with the emerging airport energy strategy.

1.2 Base Year Defined as 2007

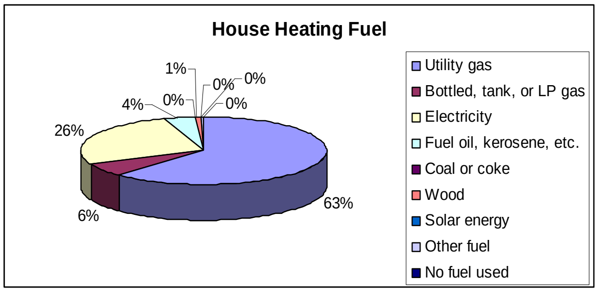
For purposes of establishing an energy use baseline in the County, a specific year had to be established. Because of the availability of complete annual usage data for County facilities, 2007 was chosen as the base year for the Built Environment. Transportation statistics data were available from 2008, and were judged to be representative for use patterns in 2007. For this Report, the base year was agreed to be 2007.

2.0 Determination of Baseline Stationary Energy Use

Wherever possible, actual energy usage data were obtained. For stationary users, the major suppliers of electricity and natural gas were approached for actual metered consumption. Usage was graciously provided for electricity by Dominion Virginia Power[150] and the Northern Virginia Electric Cooperative[151] and for natural gas by Washington Gas[152]. The assumption made by the Team is that these utilities are the primary suppliers of natural gas and electricity in the County, and that other suppliers are assumed to be *de minimis*.

[150] http://www.dom.com/dominion-virginia-power/index.jsp
[151] http://www.novec.com/About_NOVEC/index.cfm
[152] http://www.washgas.com/

Figure L.2: Residential Heating Fuel Usage[153]



Other likely stationary fuel sources beyond electricity and natural gas would primarily be propane and fuel oil. Actual consumption data were not available, so the Team looked at the U.S. Census data on residential house heating fuels as an indicator of usage (see Figure L.2). Note that the first four heating fuels cover 99% of homes in Loudoun County. Propane and fuel oil consumption for residential buildings was estimated from the ratio of each fuel usage compared to natural gas usage by U.S. Census data, and calculated from the actual reported natural gas consumption. These same ratios were applied to non-residential natural gas consumption as an estimate of their use in that category. All other sources were assumed to be *de minimis*.

Greenhouse gas emission values were provided by Washington Gas and Dominion Virginia Power.

3.0 Transportation: Methodology for Establishing the Baseline

3.1 Fuel Consumption

Calculating consumption by fuel type used a variety of data from a number of governmental sources at County, State and national levels. Loudoun County officials provided much of the data, along with additional information sourced from the web-sites of the relevant agencies.

There was insufficient data on liquid fuels' supply and usage to derive fuel consumption directly. The approach taken was to calculate it based on local vehicle registrations and transportation surveys combined with regional and national averages.

The total gasoline and diesel fuel consumed within Loudoun County was calculated in the following way. For each major vehicle the annual miles traveled was calculated by multiplying the Daily Vehicle Miles Travelled (DVMT) by 365. These were split into diesel and gasoline mileages using national averages by vehicle type. Consumption for each vehicle and fuel type was calculated using the USA average fuel rates (miles per gallon).

Daily Vehicle Miles Travelled (DVMT) statistics for 2008 were sourced from Virginia Department of Transportation (VDOT)[154]. The vehicle classes were broken out to Motorcycles, Passenger Cars, Two Axle, 4 Tire Single Unit Vehicles, Buses and Trucks (more than 2 axles). The data

[153] U.S. Census Selected Characteristics http://fastfacts.census.gov/servlet/ADPTable?_bm=y&-geo_id=05000US51107&-qr_name=ACS_2007_3YR_G00_DP3YR4&-ds_name=ACS_2007_3YR_G00_&-_lang=en&-_sse=on

[154] http://virginiadot.org/info/2008_traffic_data_daily_vehicle_miles_traveled.asp

was summarized for the Commonwealth of Virginia as well as for Loudoun County. This data encompassed all journeys across or within the county irrespective of the start point or final destination.

Vehicle type classifications are not consistent by data source. Various classifications therefore exist within the various data sets. The Loudoun County Vehicle Registration data for type and age of vehicle was used as the main data to establish the vehicle fleet mix and to insure consistency across data sources.

The USA National benchmarks for 2007, from the US Department of Transportation (DOT) Bureau of Transportation Statistics[155] were used to establish the fuel rate (miles per gallon). These differ from the US EPA and NHTSA Corporate Average Fuel Economy Standards[156] CAFE Standards, which are rarely attained under normal driving conditions. To distinguish consumption by fuel type, the US Department of Transportation statistics for consumption by fuel type by vehicle type (2007) was applied.

Recognizing that many of the journeys in Loudoun County are in consistently congested traffic conditions, the CES team arbitrarily reduced the US national average fuel rate by 10%.

Based on this approach, the estimated fuel consumption in Loudoun County for all categories of vehicles except heavy truck is 113.7 Million Gallons per year, of which 3.8 million is diesel and 109.9 million is gasoline.

Loudoun County does not have an interstate highway within its borders. As a result, DVMT data does not capture national through traffic or trucking. Long distance trucking, on the interstate highway infrastructure, is a primary means of transporting goods. Loudoun County benefits from long-distance inter-state trucking for the goods consumed by residents and businesses. To estimate this indirect use of fuel the national per capita greenhouse gas emissions for heavy trucking obtained from the US Greenhouse Gas Inventory Report: 1990-2007 submitted to the UNFCCC[157] was used to estimate the total GHG emissions attributable to Loudoun County residents. This in turn was used to indirectly estimate the total consumption of diesel fuel using the GHG indexes described below.

Heavy trucking serving Loudoun County indirectly consumed a further 37.3 million gallons of fuel, bringing the total to 150.9 million gallons.

3.2 Transportation Fuel Energy Content

To build a total picture of energy used in the County, the CES normalized all energy types to Megawatt Hours equivalent (MWhe). The energy content of each fuel type[158] was multiplied by the total fuel consumption.

Transportation energy use in Loudoun County in 2007 was a total of 5.8 Million Megawatt-hours equivalent.

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155 http://www.bts.gov/
156 http://www.nhtsa.dot.gov/portal/fueleconomy.jsp
157 United Nations Framework Convention on Climate Change - US EPA, Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2007 (April 2009) http://www.epa.gov/climatechange/emissions/usinventoryreport.html
158 Chapter 7, General Reporting Protocol, http://www.climateregistry.org/tools/protocols/general-reporting-protocol.html

3.3 Transportation Greenhouse Gas Emissions

The greenhouse gas (GHG) emissions produced per gallon of gasoline and diesel by greenhouse gas (CO_2 – carbon dioxide, N_2O – nitrous dioxide, and CH_4 - methane) was calculated using The Climate Registry[159] benchmarks. The result for each was added together to obtain a carbon dioxide equivalent ($CO2_e$) GHG emissions level for gasoline and diesel. The total transportation GHG emissions are the product of multiplying these factors by the total fuels consumed on an annual basis. As indicated above, the impact of heavy trucking was derived from the US national data submitted to the UNFCCC.

For all transportation types, the total GHG emissions for the County are 1.4 million tons of CO_e.

Three commonly used indexes were derived from this total. GHG per capita was calculated by dividing the total GHG emissions by the County population. GHG per mile resulted from dividing total emissions by total miles travelled for all vehicles except heavy trucks. GHG per kilometer was calculated in the same way to create an index commonly used for international benchmarking.

3.4 Comments on Other Transportation Energy and Emissions

The following categories are not included in the transportation calculation: off-road, recreational boats and ships, commercial maritime, aircraft related, rail, and all military uses.

Besides Dulles Airport, Leesburg does have its own airport. The Airport buildings are assumed to be captured in the utility consumption data for the County. Aviation fuel consumption data were requested, but not available for the airport. All air travel fuel consumption, whether from Leesburg Airport or elsewhere, has been excluded from this Report. On a national basis, Civil Aviation would add approximately 0.6 metric tons of GHG per capita, but has not been added to the total GHG per capita given in the Report for the County.

The transportation energy consumption and resultant GHG emissions do not take non road transportation into account. Any buildings associated with quarry, forestry and farm operations are assumed to be captured in the utility consumption data for the County. Any mobile machinery fuel consumption data were not available, and has been excluded from this Report. It is assumed to be *de minimis*.

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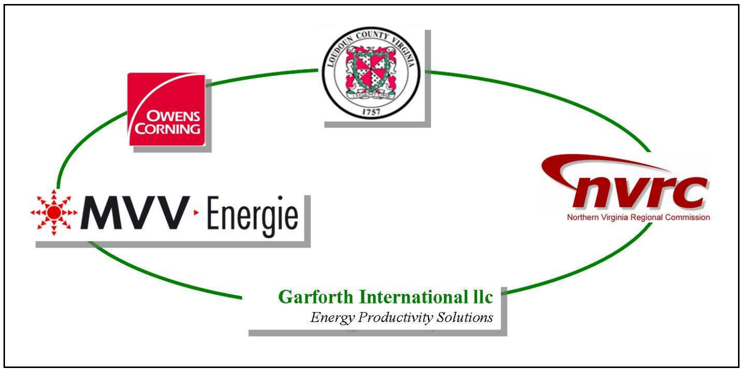
[159] See http://www.theclimateregistry.org/ These standards are also traceable to the World Resource Institute and the World Business Council for Sustainable Development

Appendix M: CES Team

CES Team

The development of the CES is being done by a Team that represents a mix of local, regional and global expertise, along with substantial community engagement.



CES Team – Local, Regional, and Global Expertise

In addition to Loudoun County Staff, the Core Team includes members that bring complimentary perspectives.

NVRC[160] brings in-depth best practice benchmarking along with a local perspective as to how the Loudoun CES could be a catalyst for Northern Virginia as a whole.

Owens Corning[161] has wide-ranging knowledge of North American energy efficient residential and commercial construction and renovation.

MVV decon GmbH, as the consulting arm of MVV Energie AG[162], applies its knowledge of highly-efficient municipal energy and water systems as the multi-utility service provider in its home town of Mannheim and six other German cities, and also as advisor to cities and countries globally.

Garforth International provides a global and local business view to the integrated CES recommendations.

John Palmisano, a founding partner in eTrios, brought twenty years of environmental assets trading to give perspectives on possible impacts of climate change legislation and credits.

Dianne Perkin from Terra Sol conducted the bulk of the research and analysis on the transportation aspects.

Dominion Virginia Power, NOVEC, and Washington Gas are also actively engaged with the CES Team providing utility and regulatory data, and providing a valuable utility perspective.

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160 http://www.novaregion.org/
161 http://www.owenscorning.com/
162 http://www.mvv-energie.de/cms/konzernportal/en/homepage.jsp